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ENGINEERING AND

BOILER HOUSE REVIEW

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VOL. 76 NO. 3 • THE PIONEER STEAM JOURNAL • MARCH, 1961

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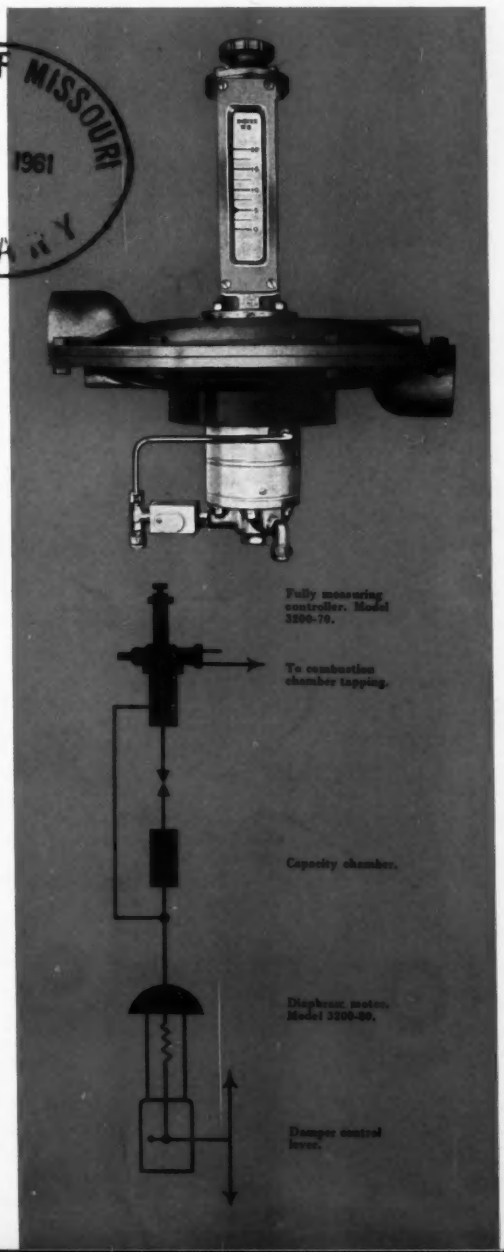

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The Editor will be glad to receive and consider original contributions, correspondence, etc., of a suitable nature for publication. Stamped and addressed envelopes should be enclosed for the return of any matter considered unsuitable

Published monthly by

ENGINEERING REVIEW PUBLISHING CO. LTD.
19-20, NOEL STREET, LONDON, W.1

Annual Subscription Rate, 40s., including postage.

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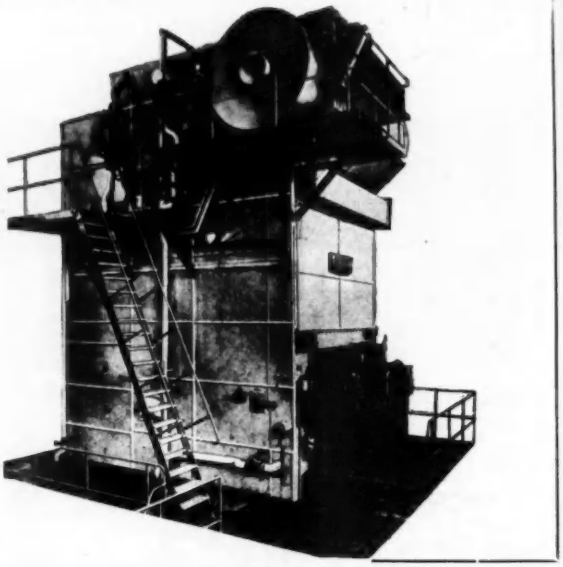

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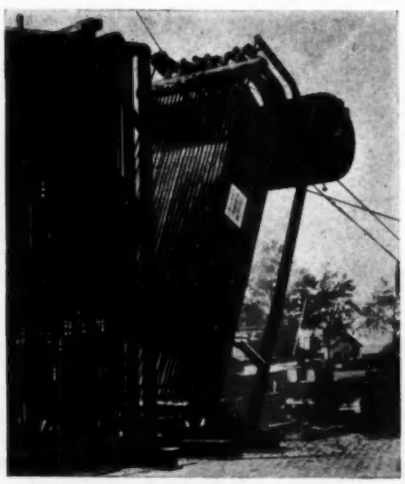

(Left) Delivery as a single, works-assembled unit.

(Right) Erection of larger unit on site from a few pre-assembled, easily-transported sections.

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Engineering and
BOILER HOUSE REVIEW

MARCH 1961
VOLUME 76 No. 3

PROGRESS IN ELECTRICITY GENERATION

DURING the past 12 years, development of the science and technique of steam and power generation in Great Britain has been outstanding. Progress really commenced in earnest during the years immediately following the second world war, which had left the country with a serious deficit in generating capacity: thus it was necessary to overcome this shortage as quickly as possible, and at the same time adopt an interim policy of standardisation. As a result, two sizes of turbo-alternator sets were decided upon as the most suitable to allow for rapid construction, and hence early commissioning. These were—the 30-MW set with steam conditions of around 750 lb./sq. in. and 860 deg. F., and the 60-MW set designed to operate at the improved conditions of 950 lb./sq. in. and 950 deg. F.—each of these machines showing certain advances over the pre-war sets, and being well suited to the conditions and demands then prevailing. Although the early 60-MW machines were steamed by more than one boiler, the later machines of this capacity, particularly those installed after nationalisation of the electricity supply industry in April 1948, saw the introduction of the 515,000, and 550,000 lb./hr. boiler units—then the largest boilers in the country. In due course, some of these boilers were installed with turbo-alternators as unit sets—thus forming the first examples of such an arrangement. Furthermore, such installations emphasised the state of pre-eminence attained by the high-capacity pulverised-fuel-fired boiler.

Far-reaching advances were made in the design, and installation of large generating units and their associated boilers after nationalisation, under the British (later Central) Electricity Authority, prior to the formation of the Central Electricity Generating Board as from January 1st, 1958. During the latter part of this period 100, 120, 200 and 275-MW sets were ordered, the evaporative capacities of the associated boilers having reached figures of 830,000; 860,000; 1,400,000 and 1,950,000 lb /hr. respectively. In addition, orders had been placed for two 550-MW machines, each of which had two alternators. One of these is a fully cross-compounded machine, with a high-pressure line and a separate low-pressure line; the other is cross-compounded on the high-pressure turbines of the two lines only; both lines having identical intermediate-pressure cylinders and exhaust cylinders. The unit boilers to steam these sets have a maximum rating of 3,750,000 lb./hr., with superheater outlet steam conditions of 2,400 lb./sq. in. and 1,055 deg. F., reheat steam temperature being also to the latter figure.

Since then, technology has advanced still further; two 300- and two 350-MW sets are under construction, while orders have been placed for 375-MW sets with single alternators, and to operate with super-critical steam conditions of 3,500 lb./sq. in., with a temperature of 1,100 deg. F., and reheat to 1,050 deg. F. Now, 500-MW single-alternator sets have come to be regarded as a standard for the future, and the C.E.G.B. have received the consent of the Minister of Power to construct the first of two 2,000-MW stations—viz. at West Burton in Nottinghamshire, in each of which, four such 500-MW machines will be installed. This represents the largest single order (valued at £15 million) ever to have been placed by the Board to date for generating equipment for an individual power station. This station will, when completed by the end of 1967, have an installed generating capacity greater than that installed in any power station in Western Europe.

These 500-MW units which will be the world's first single-line machines of this capacity, will be designed and constructed by the English Electric Company, and will represent the latest development in the range of large single-line units now being supplied by that company to the C.E.G.B. The large increase in the alternator output has been made possible by improvements in cooling technique, by the production of large forgings, and by the relaxations in transport limitations on the size and weight of components that can be carried by road. Thus it has been necessary to design the alternators with three main components—the rotor, and the inner and outer stators—instead of the usual two. The turbines will operate with stop-valve steam conditions of 2,300 lb./sq. in., and 1,050 deg. F., with reheated steam at the same temperature supplied to the intermediate pressure cylinder.

The associated boiler plant for these four sets represents the largest single order so far placed by the C.E.G.B. for steam generating plant; its total value is approximately £19 million. Each of the four reheat boiler units will have a maximum evaporative capacity of 3,450,000 lb./hr., and they are to be designed and installed by International Combustion Limited—the design being a natural development of that adopted for the boiler being supplied by the same company for steaming the first 550-MW set in this country—at Thorpe Marsh Power Station. For the new boilers, however, the furnaces will be of single sub-divided design employing tangential firing of the fuel. When the station is complete, the four boilers will consume about five million tons per year of low-grade coal taken from the northern part of the East Midlands coalfield. The second of the two proposed stations (Holme Pierrepont) was the subject of a Public Inquiry which ended at Nottingham in January. If approved, the boilers in this station would consume a similar annual tonnage of coal from the southern part of the coalfield.

These striking advances which have been made, result in the capital cost per kW installed being reduced from about £67 in the case of 30-MW sets, to about £40 per kW for the large machines now planned. Furthermore, a 30-MW set for example, weighs about 8.3 tons per kW capacity, whereas the corresponding weight for the present large-capacity machines will be about 3 tons, while the volume of station buildings has been reduced from 39.4 cu. ft./kW in a typical 180-MW station with 30-MW sets, to about 22 cu. ft. in a large station with 500-MW machines.

Points and Pointers

CHANGES IN ORGANISATION OF U.K.A.E.A. Changes in the organisation of the United Kingdom Atomic Energy Authority will take effect on April 1st. In their report dated July, 1959, on the Industrial Group of the Atomic Energy Authority, the Select Committee recommended that certain aspects of the Authority's organisation should be reviewed after a reasonable period. This review has now taken place and the Authority have decided upon the following changes—including the establishment of a new group—designed to improve co-ordination and efficiency. Sir William Penney, K.B.E., F.R.S., who, in 1959, succeeded Sir John Cockcroft as Member for Scientific Research, has now been appointed deputy chairman of the Authority, and will be primarily responsible for scientific and technical co-ordination throughout the Authority. Reactor design and development will be concentrated, to the greatest possible extent, in one Group of the Authority, with the major development facilities required for this purpose under the control of the Group. The structure of this Development and Engineering Group will be modified for this purpose. It will be renamed the Reactor Group, and will be responsible for the design and development of reactors; and for relations in this field with industry at home and with overseas countries. The Winfrith Research Establishment, which has responsibilities in the same field, will be transferred from Research Group to Reactor Group. The Development and Engineering Group's existing responsibilities for the design and construction of plant, works and buildings will be transferred to a new Engineering Group, which will also take over from the Production Group its responsibilities for the design and inspection of fuel elements for production purposes. Apart from the transfer of the Winfrith Research Establishment, the structure and responsibilities of the Research Group remain unchanged. The Weapons Group is unaffected by the new arrangements. Sir William Cook, C.B., at present Member for Development and Engineering, will in future be known as Member for Reactors. The responsibilities of Sir Leonard Owen, C.B.E., will now extend over the Production and Engineering Groups, with the title of Member for Production and Engineering. Other appointments which will take effect from April 1st, are:—*Director of the Research Group*:—Dr. F. A. Vick, O.B.E. (who will continue as Director of A.E.R.E. Harwell). *Managing Director, Reactor Group*:—Mr. R. V. Moore, G.C. *Managing Director, Engineering Group*:—Mr. J. B. W. Cunningham, M.I.Mech.E., and *Managing Director, Production Group*:—Mr. J. C. C. Stewart, C.B.E., F.Inst.P. It may be remembered that on July 1st, 1959, the Industrial Group was split into two new Groups: the Production Group; and the Development and Engineering Group. The relevant recommendations of the Select Committee were:—"The Authority should consider whether more formal arrangements are required for the co-ordination of the work of the Production, and Development and Engineering Groups after the present arrangements have been tried over a reasonable period. In view of the recent increase in the number of separate research and development organisations within the Authority, the system of co-ordinating work being done at the various laboratories, in order to avoid duplication or lack of proper balance, should be reviewed after a reasonable period of experience of the new organisation."

TENTH ELECTRICAL ENGINEERS EXHIBITION The Minister of State, Board of Trade, the Rt. Hon. Frederick Erroll, M.A., A.M.I.Mech.E., M.I.E.E., M.P., will open the Tenth Electrical Engineers Exhibition at noon on Tuesday, March 21st. Before his appointment as Minister of State, Mr. Erroll, himself a qualified electrical engineer, was a director of several engineering and mining companies. Educated at Oundle and Trinity College, Cambridge, he started his career with (the then) Metropolitan-Vickers Electrical Co. Ltd., later moving to the staff of the research department of Evershed & Vignoles Limited at Chiswick. During the second World War, Mr. Erroll saw service in Italy, India and Burma. He attained the rank of colonel, and took part in the first large-scale amphibious operation. He carried out various missions in Germany and Austria for B.I.O.S. Mr. Erroll has been Conservative M.P. for Altrincham and Sale since 1945. He was a member of Parliamentary delegations to Germany (1946), West African Colonies (1947), Burma (1950) and U.S.S.R. (1954). From 1949-52 he was deputy-chairman of the Parliamentary and Scientific Committee; Parliamentary Secretary to the Ministry of Supply, 1955, to the Board of Trade, 1956. In 1958 he was appointed Economic Secretary to the Treasury. In 1948, jointly with the late Earl of Verulam, he read a paper on "High Voltage Direct Current Transmission" to the Institution of Electrical Engineers.

COAL PROSPECTS On Wednesday, February 8th, the Rt. Hon. Alfred Robens, chairman of the National Coal Board, addressed the National Industrial Fuel Efficiency Service Conference in Glasgow. Mr. Robens said that he welcomed the opportunity of reviewing the prospects of the coal industry and especially its prospects in Scotland. He reminded the conference that about one person in 10 in Scotland depended directly upon the coal industry for a livelihood, and that one ton of coal in every ten produced in Britain was furnished by Scotland. The Board looked to the Scottish coalfield, he added, to maintain roughly this contribution in future, some 18,000,000 to 20,000,000 tons out of the total of 200 million to 215 million tons envisaged in the Board's plan for 1965. The chairman

went on to outline some of the grave risks involved in subjecting the coal industry to rapid changes in demand. The coal industry carried a heavy burden of fixed charges which scarcely varied with output, he said, and we were now at the stage where the less coal we produced, the dearer each ton became. A large part of the decline in coal consumption between 1956 and 1959, he suggested, was attributable to intense competition from oil. The oil industry was confident that its long term problem would be scarcity, not surplus, as at present. We were also assured by leading oil men, he added, that fuel prices were unduly low. It would surely be unwise in these circumstances, Mr. Robens said, to jettison coal-producing capacity when we knew how difficult, uncertain, and expensive re-expansion would be. Mr. Robens went on to say that the effects of the oil industry's operations on the United Kingdom's balance of payments were not revealed to the public. He could not affirm categorically, he said, that the operations of the oil industry in 1959 or 1960 resulted in a very large net loss to Britain as far as overseas payments were concerned; but that is what all the available information suggested.

FIRST DESIGN APPRECIATION COURSE FOR SENIOR ENGINEERS

Following its two successful design appreciation courses for junior engineers, the Council of Industrial Design is organising a course for senior engineers. It will be held from April 25th-28th inclusive and should not, of course, be confused with the third junior course which finishes early in April. The senior course will have three main aims—to impart an appreciation of design in its widest context, to show how industrial design can be put into practice, and to emphasise the growing application of industrial design in engineering today. Particular attention will be paid to organisational questions as well as to general design appreciation, so the course should be of special interest to senior engineering staff with executive control or responsibility for engineering design teams. Lectures in the first part of the course will deal with the development of industrial design and with analyses of the factors which constitute good design, with special reference both to the part played by form, colour and composition and to human engineering or ergonomic aspects. In the second part of the course, talks on design organisation directed towards using industrial design to the best advantage will be held with a leading manufacturer, a leading industrial designer and representatives of the Council of Industrial Design. The course will be held in London, and will be residential in order to make the fullest use of available time and encourage group discussion.

GEORGE KENT LIMITED ACQUIRE CONTROLLING INTEREST IN ITALIAN ASSOCIATE COMPANY

As forecast in the chairman's review, circulated with the company's accounts some few months ago, it is now announced by George Kent Limited, Luton, that the proposed acquisition of 51 per cent. of the share capital of the Tieghi Company of Milan and Lenno has been effected. A new company has been formed, viz.:—Kent-Tieghi S.p.A., and this has purchased the whole of the assets and goodwill of the Tieghi Company. It is confidently expected that the new company will continue to expand and fortify the trading and technical abilities already attained by the Tieghi Company, it having for a considerable time enjoyed a leading position among the industrial instrument and controls manufacturers of Italy. With a background of several years of previous close technical and commercial collaboration between George Kent Limited and Tieghi, it is foreseen that the parent company and the new subsidiary will progressively arrive at an identical range of products and programme of future development, of much value in maintaining and expanding group activity in Europe—more particularly within the Common Market—and elsewhere. Kent-Teighi have modern and well-equipped works at Lenno on Lake Como, and head offices in the centre of Milan. Their products at present include recorders and controllers for flow, pressure and temperature of liquids and gases (both circular and rectangular chart) using pneumatic control systems, and supported by an extensive series of primary elements, relays and actuators. More recently, a range of miniature pneumatic recorders and controllers, and force-balance transmitters, has been put into quantity production. The company also holds an exclusive import and distribution franchise for the American Conoflow range of pneumatically-operated control valves. The factory at Lenno has just been enlarged from 35,000 sq. ft. to 65,000 sq. ft., and the number of employees has risen from 140 to 220.

INSTITUTION OF PLANT ENGINEERS ANNUAL DINNER

The ninth annual dinner of The Institution of Plant Engineers was held at the Connaught Rooms, London, on February 17th, when some 150 members and guests were present. The principal guest was the Rt. Hon. Alfred Robens, recently appointed chairman of the National Coal Board. Proposing the toast of "The Institution," Mr. Robens paid tribute to the work of plant engineers in the past, and made particular reference to the immediate post-war years when the role of the plant engineer was essential for the Nation's recovery. In looking to the future, Mr. Robens made reference to the Institution's programme for the period 1960-61, during which no fewer than 28 lectures are to be given on subjects concerning boiler and heating plant. Mr. Robens expressed the hope that the Institution would be honoured before long by being given a royal charter. He went on to express his confidence in the future of the coal industry in which, he said, his aim as chairman of the National Coal Board would be to put the industry on a sound basis. He stressed the importance of good relations between supplier and consumer, and gave as his target stability of prices and a constant quality level of coal. In his response, the President of the Institution, Mr. E. C. Stevens, M.A., B.Sc., etc., expressed his belief that this country might soon become overcrowded with specialist engineers, and he thought it unfortunate that, except perhaps at university level, no course existed which taught the training in fundamentals so essential to a plant engineer. Mr. Stevens concluded by thanking Mr. Robens for being present so soon after his appointment as chairman of the Coal Board. The toast "The Guests" was proposed by Mr. G. D. Jordan, M.Eng., A.M.I.Mech.E., etc., and was responded to by Dr. D. T. A. Townend, C.B.E., Director-General of The British Coal Utilisation Research Association.

Welded Boilers and Pressure Vessels

A SYMPOSIUM on the subject "Pressure-Vessel Research Towards Better Design" was held in London recently by The Institution of Mechanical Engineers, in co-operation with the British Welding Research Association. In one of the papers, J. F. Lancaster, B.Eng., of the Kellogg International Corporation, London, compared the laws governing the construction of welded boilers and pressure-vessels in a number of countries in Europe, the Commonwealth and North America. On the basis of this comparison the author of the paper appraised possible future lines of development of British codes. Because of their provisional nature, two proposed codes were not considered in detail, although they may influence European codes, particularly by encouraging the adoption of yield point instead of ultimate tensile strength as a criterion of design stress. These provisional codes are the INSTA code, which is a recommendation for a common basis for the development of national standards in Denmark, Finland, Norway and Sweden, and the I.S.O. boiler code which is only in draft form. Extracts from this paper are given in these notes, as are abstracts from a paper entitled "Pressure Vessel Design Requirements in the Near Future," by W. B. Carlson, D.Sc., of Babcock & Wilcox Limited, London.

In the paper entitled "A Comparison of United States, European and British Commonwealth Codes for the Construction of welded boilers and pressure-vessels," Mr. Lancaster, in dealing with laws and governmental regulations, pointed out that because of the hazards involved in their use, the construction of boilers and pressure-vessels is subject to regulation by a Government department in most of the countries under consideration. The degree of legal control varies a great deal; on the one hand, in countries such as Italy and Austria, rules for construction are set-out in detail in a ministerial decree and in others such as India and New Zealand, the code is written and issued by a Government department, and is, in fact, a Ministry regulation. In Great Britain the law gives the minimum of guidance as to means of construction. Other countries, such as America, Canada, and Australia, have adopted a method of regulation which lies between these two extremes, the Government or local authorities giving approval to a code written by a body of professional engineers, thereby vesting this independent code with legal authority. The administration of boiler and pressure-vessel codes varies, similarly the majority of countries having an inspectorate whose duty is to give rulings on the interpretation of the code, to approve drawings and to carry out physical checks during construction. In many cases this inspectorate is part of a Government department, whilst in others there is a Government-approved inspection agency that performs this function.

In America, the states and municipalities which have adopted the American Society of Mechanical Engineers (A.S.M.E.) Code, supervise construction, broadly through their inspectorate, but checking of drawings and detailed inspection is carried out by an authorised A.S.M.E. inspector. In Great Britain there is no Government or Government-approved inspectorate responsible for supervising boiler and pressure-vessel construction, inspection being carried out by purchasers, by Lloyd's, by the Associated Offices Technical Committee (A.O.T.C.), or by the various insurance companies.

There is, therefore, a wide variation in the degree of legal authority given to construction codes and the degree of governmental inspection of boiler and pressure-vessel manufacture in the countries examined. Experience tends to show, however, that standards of safety achieved in these various countries are almost uniformly high. This desirable situation results more from a combination of sound engineering practice with commercial integrity, than from any form of legal compulsion.

Material specifications, fabrication and inspection

In the specifications for carbon-steel boiler plate there is general agreement as regards the specified tensile properties. There is, however, considerable variation in the degree of control over chemical composition. The German Standard—DIN 17155—lists the available carbon and low-alloy boiler-plate steels together with their mechanical properties at elevated temperature. This type of specification is of real value to the designer, who can obtain from it a clear definition of the properties of the material he specifies. Estimates of the elevated-temperature properties of steels given in specifications vary quite considerably. In general, Continental European codes tend to be more conservative than the A.S.M.E. Code in the design stresses permitted for carbon-steel in the creep range, although results for comparable alloy-steels are similar. There is a natural difference between the maximum carbon contents specified for Continental European steels, and those specified for American steels, both in the carbon and low-alloy range. There is a tendency for the acceptable carbon content of steel to be higher in the United States than in European practice, and this tendency is reflected in the specification figures.

A problem peculiar to Britain is the multiplicity of specifications for boiler and pressure-vessel plate. B.S. 14, originally designating plate for riveted marine boilers, is still widely used for welded pressure-vessels, although it sets a quality standard below that normally required in current engineering practice, and competes in a most undesirable way with the other two standards—B.S. 1633 and B.S. 1501-151. It is inevitable that a lower-quality standard should tend to persist, and action to define and specify the quality level required for a British standard boiler plate, applicable equally to pressure-vessels, is urgently required.

The majority of codes pay special attention to welding; the A.S.M.E., Australian, and Swedish codes have a separate section devoted to the application and control of welding. In Europe it is normal to require test plates to be welded with longitudinal seams; this constitutes the

most common form of quality control over welding. In addition, some countries require welding operators to be individually qualified. In the United States and Canada, on the other hand, the welding procedure and welding operators must be qualified, but routine tests taken with longitudinal seams are not necessarily required.

Radiography is the only non-destructive testing technique generally recognised for welds, and it is common practice to give credit in terms of increased allowable joint efficiency in the case of vessels subject to radiographic control. A further credit is given for stress-relieving and for other fabrication procedures in accordance with the quality level which is achieved. In general, the codes examined are deficient in that, although they indicate different levels of quality of fabrication, little or no guidance is given to designers as to the services for which the different quality levels should be specified. An exception is Lloyd's Rules, which gives pressure and temperature limitations for each of the three classes of vessel. However, this code was not designed for, and does not consider, the needs of the modern petroleum, chemical, and petro-chemical industries for which the nature of the service, in particular the degree of hazard involved, must be taken into account in defining quality classes according to service.

Design

In comparing the design details of the various codes, the most immediately obvious division is between those countries which permit a design stress equal to two-thirds of the yield or proof stress (Holland, Germany, and the Scandinavian countries) and those which limit the design stress to one-quarter of the ultimate tensile stress (Britain, the British Commonwealth, France and the United States). Use of the former criterion leads to considerable economy in the use of material for carbon-steel pressure-shells, as compared with the older system. Such economies are even more pronounced when high-yield-point steels are employed. At temperatures over approximately 650 deg. F., where the possibility of failure by creep limits design stress, the situation changes. The A.S.M.E. Code is much less conservative than the remainder, and at a temperature of 900 deg. F. permits a working stress about twice that which is allowed by the German code.

The amount and character of design information given varies considerably. The Austrian and Swiss codes cover essentials only, while the Swedish and Dutch codes have both been re-written in recent years and achieve a clear presentation of modern design techniques. The German code has, until just recently, lacked information about some essential matters (shells under external pressure, for example) and has lacked a clear statement of quality control requirements for welding, but these deficiencies are being remedied and the boiler code, Werkstoff and Bauvorschriften, is currently being revised and re-issued under the title "Dampfkessel-Bestimmungen."

The Commonwealth codes (except in the case of Canada, which accepts the A.S.M.E. Code) have been influenced by current British code and, in particular, Lloyd's Rules; the Australian code also has some affinities with the A.S.M.E. Code. The A.S.M.E. Code itself, has a wider coverage of design than any of the other codes examined, although the presentation has suffered as a result of its growth.

In considering the codes and their developments, the first requirement is to decide upon the essential functions of the boiler and pressure-vessel construction code. Obviously, one of these functions is to achieve safety in use. Some countries, which are not lacking in technical resources, Belgium and Israel, for example, have neither code nor any detailed governmental supervision of construction, yet they manage to achieve adequate standards of safety. In Great Britain there are a number of codes but no direct legal enforcement of their use and at the same time no evidence of lack of safety in operation. Therefore, although the content of a code must be such as to ensure safety, considerations of safety do not necessarily govern its line of development.

The second function of a code is standardisation. The industry manufacturing and using boilers and pressure-vessels is a large one and it is essential to have some degree of standardisation in the manufacture of its apparatus. Standardisation can help to reduce costs at all levels: at the design level, by simplifying design procedures; at the supply level, by standardisation of the size and design of nozzles, etc., and in construction, by minimising the need for independent detailed decisions by inspectors. So far as this country is concerned, the main obstacle to effective standarisation is in the existence of three main codes applicable to boilers and pressure vessels, namely, the British Standard Codes which include B.S. 1113 and B.S. 1500, Lloyd's Rules, and the A.O.T.C. Rules. The existence of these different codes in turn generates a multiplicity of material specifications, results in different standards being set for vessels having similar duties, adds to the amount of drawing-office work, reduces the possibility of standardisation in construction, and adds considerably to the burden of inspection.

An important step towards economy in the industry concerned would be made if a unified code acceptable to all the authorities concerned could be developed in Britain. Possibly the most controversial issues concerning the development of pressure-vessel design in Britain are—whether it is justifiable to increase the allowable design stress, and whether the basis for assessing the allowable stress at normal temperature should remain the ultimate tensile strength of the material, or its yield strength. The current trend in Continental Europe is towards an acceptance of the yield stress (or proof stress) divided by a factor of 1.5 as the permissible working stress in a vessel shell. In Germany such a method of calculation has been used, with official approval, for some 20 years, and there has been no evidence of lack of safety in operation of vessels so designed, due to inadequate wall thickness. As far as Great Britain is concerned, it is very doubtful whether the introduction of a revised basis for design would result in greater standardisation of manufacture. In fact, it is more likely that such a revision would form part of an additional code and would add to the diversity.

The interests of overall economy would, at the present stage, best be served by the unification of British codes and by broadening the scope of the pressure-vessel section to cover the high-alloy and non-ferrous materials currently used in the chemical and petroleum industry. Future code development is only likely to be effective if it starts from this firm foundation, and develops on the basis of common agreement, acceptable to manufacturers, users, and classification societies alike.

Summary

There are wide differences in the degree of local authority given to codes and in the scope of the codes examined. Experience suggests, however, that this difference is not reflected in different levels of safety achieved by vessels constructed in the different countries. There is broad agreement as to the essentials required for sound design, except that in one group of countries the permissible design stress is equal to one-quarter, or less, of the ultimate tensile stress, whilst in the other group, the permissible stress is two-thirds or less of the yield point or proof stress of the material. Great Britain and France are exceptional among the countries examined in that, although national codes exist, no single code is either officially recognised, or universally accepted, nor is any code-administering body recognised or accepted. It is considered that the establishment of a single code, covering boilers and pressure-vessels, and having a single administrative body, would be a most desirable step towards standardisation and economy in Britain, and that any development towards increased permissible stresses should be secondary to the unification and strengthening of existing codes.

PRESSURE-VESSEL DESIGN REQUIREMENTS IN THE NEAR FUTURE

The conventional method of calculating the scantlings of a pressure-vessel may be described as a " single-design-stress " approach to the problem. The " Design stress " is derived by dividing arbitrary and somewhat large factors of safety into several conventional mechanical strength properties (ultimate tensile strength, yield and creep rupture stress) of the material, at the required temperature, and selecting the lowest dividend as the design stress. This stress is inserted into conventional formulae for calculating the minimum thicknesses of cylindrical, spherical, toroidal, and conical parts of the pressure vessel. The factors of safety currently in use are of the order of $4\frac{1}{2}$-3 on the ultimate tensile strength, and 2-$1\frac{1}{2}$ on yield or creep rupture stress.

Obviously, no move to improve pressure-vessel design methods can culminate in truly economic designs so long as minimum permissible thicknesses are tied to such arbitrary design stresses. Let a new approach, therefore, be made by defining an idealised pressure-containment project as being one in which the vessel is comprised of one thin pure geometric shape, such as a sphere, or an infinitely long cylinder, having only pure membrane stressing, with no deliberate or accidental stress intensifications, and where the conditions of operation comprise only steady internal pressure at constant temperature, with no corrosive media present, and no limitations on elastic inflation with pressure. Under these ideal conditions, there would be no reason why the membrane stress should not be 99 per cent. of a suitable minimum-probability value of the yield or creep rupture stress of the material at the working temperature. This then could be the basic design stress given in the codes. The design stress should not be derived on the assumption that there will always be stress intensifications of the order of 2 or $2\frac{1}{2}$ due to the presence of un-reinforced holes, or improperly designed discontinuities. This merely encourages the automatic acceptance of the inevitability of inferior design. On the contrary, there should be a bonus for good detailed design and accurately executed construction. It should take the form of permitting a high design stress in areas where there are no stress intensifications, and lowering it only where there are significant departures from ideal design or operating conditions. Such departures may take one of two general forms: the presence of unavoidable stress intensification due to either design or manufacturing departures from pure shapes ; or the possibility of there developing in the pressure vessel, modes of failure other than simple yield or creep.

These two types of departure from ideal conditions will be considered separately. Dealing first with stress intensification ; during the last 20 years, much effort has gone into both experimental and mathematical determinations of the detailed stress distributions in various shapes of pressure part. This effort on stress analysis is potentially one of the keys to the creation of better designs. Good though the work on stress analysis has been, it represents less than half the story for true design purposes. It is relatively simple to determine the stress system in a pressure part, but to date there has emerged no generalised method of interpreting an intensified stress system in terms of the design thickness to be used for the conditions of operation. Broadly speaking, it is known that a stress intensification, which involves a large conjoint cross-section of highly-stressed metal, must be taken at its numerical value, whereas an equal intensification, which is highly concentrated, and supported by lower-stressed material, is of less concern. However, no numerical formula of general applicability to practical cases has yet been promulgated. This is partly due to the variety of modes of failure which may develop in a pressure vessel.

Before the effect of an elastic stress intensification on the performance of a pressure vessel can be assessed, it is necessary to assume the mode of failure which is to be considered. This may be one, or a combination of several, as follows:—

(i) Excessive elastic deformation, leading to unacceptable change of shape, to mal-distribution of support loads, to leakage at mechanical joint, to elastic instability or buckling.
(ii) Excessive short-term plastic deformation, leading to similar troubles as above, including plastic instability or buckling.
(iii) Excessive long-term creep, leading to low-elongation creep cracking, to an unacceptable change of shape, or to plastic instability or buckling.
(iv) High strain fatigue, leading to cracking, and eventual leakage or rupture.
(v) Corrosion fatigue, leading to the same.
(vi) Stress corrosion, leading to the same.
(vii) Fracture initiation and propagation under low applied stress.

A large amount of research work is needed, to translate representative types of magnitudes of elastic stress intensifications into their corresponding effectiveness factors, when designing against each one of the above mentioned modes of failure to perform the required duty. At first glance, the task might seem impossibly complex, but simplification results from the proper selection of materials. Also, design against some contingencies may guard against certain others, and few specific vessels would be potentially subject to all the contingencies mentioned. It is, perhaps, pertinent to point out that a vessel has to withstand not only the conditions imposed during operation, but also those prevailing during manufacture,

transport, erection, pressure-testing and start-up. All these conditions should be known to the designer. Moreover, the initial pressure test should be removed from the realm of arbitrary regulation, and should become a test, deliberately designed to demonstrate certain pre-stated features of the vessel's ability to perform the duty which will be imposed. From the foregoing thesis the conclusions may be summarised as follows:—

(i) Raise the basic coded design stress to the highest value permissible for pure membrane stressing and idealised steady pressure and temperature.

(ii) Factor separately each significant departure from pure membrane stressing and idealised steady pressure and temperature.

(iii) Set in motion the necessary additional research work to determine the real effects of departures from pure membrane stressing and idealised steady pressure and temperature, in relation to the modes of failure against which pressure-vessels have to be designed.

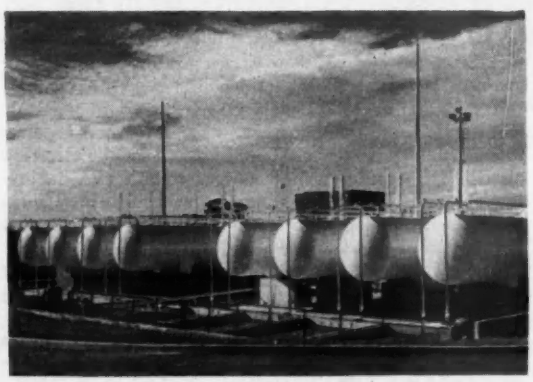
(iv) Act promptly in revising both mandatory and recommended codes upon the results of authenticated research and experience.

(v) Revise the basis of the initial pressure test so that it shall be deliberately designed to demonstrate prestated features of the vessel's ability.

It is submitted that the principle behind conclusions (i) and (ii) could be adopted now, even though the departure factors had to be established on experience and date available now. With the accumulation of research and experience, and the advent of superior designs, the departure factors would be expected to diminish.

NEW BUTANE/AIR PLANT

Although **W. C. Holmes & Co. Ltd.** have designed and installed numerous liquefied petroleum gas plants during recent years, the recently commissioned butane/air plant at the Hereford works of Henry Wiggin & Co. Ltd. is of particular interest, as it is the largest and most comprehensive installation in this country outside the gas industry. The plant has been designed to store 500-tons of liquid butane (the equivalent of some 240,000 therms) and to supply the total gas requirements of a modern factory covering 50 acres. In operation, butane vapour is mixed with air, which serves a dual purpose; it reduces the high heat-content of the vapour to a usable value and it also reduces its dew-point. This reduction of dew-point eliminates the possibility of the vapour separating from the air and condensing in the distribution pipe-lines. The liquid butane is transported from the refinery to Hereford in specially-designed road tankers. To speed up "turn-round" of the tankers, a special method of liquid transfer, known as the vapour pressure method, has been adopted. Compressors draw vapour from the storage vessels, compress it, and pass it into the tanker. This displaces the liquid which flows from the tanker into the selected storage vessel. When the liquid ceases to flow, the valve system of the compressor is reversed, so that the vapour remaining in the tanker is transferred to the storage vessel. There are eight storage vessels at Hereford, each being 10 ft. dia. × 56 ft. 6 in. long. When these vessels are filled to 86 per cent. of their total capacity, the required total of 500-tons of liquid butane is reached. The remaining 14 per cent. of capacity forms the vapour space and allows for expansion of the liquid. There are four vaporisers, each of which consists of a vertical cylindrical pressure-vessel containing internal heating-coils which are heated by saturated steam. Each vaporiser has been designed to produce 24,000 cu. ft./hr. of butane vapour. As on the storage vessels, excess-flow valves, safety-relief valves and pressure gauges are fitted. After vaporisation, the butane vapour is passed through suitable stages of pressure reduction to the inlets of six Holmes-Kemp carburettors where the butane, at near-atmospheric pressure, is mixed with the correct amount of air. Since the butane/air mixture is required at a pre-set and constant calorific value, the ratio of butane to air must be closely governed. The ratio is set manually, each carburettor being turned to the Wobbe index recorder. When the correct setting is obtained, the hand-wheel is locked against interference, and the ratio of butane to air remains constant over the whole range of output. As the plant is required to operate 24 hours a day, all electrical controls and gauges have been positioned on a central control panel to reduce personnel requirements on the various shifts. The panel carries:—pressure-gauges for steam, butane and butane/air; tank contents gauges; flow and Wobbe number recorders; indicator lights to indicate high and low Wobbe, low butane and butane/air pressures. The panel also incorporates stop and start buttons for the six mixing-unit motors and for the air-supply fan motor. A system of safety devices and interlocks is provided on all mixing units so that in the event of incorrect operation, failure of butane or electrical supplies, alarms first indicate the fault, and then, if the fault is not corrected, the plant will automatically shut down. In designing this plant, particular attention had to be given to the safety precautions peculiar to liquefied petroleum gases, and steps have been taken to meet all foreseeable eventualities. The absence of specific legislation covering the installation of butane/air plants necessitated the close co-operation of the local authority and appropriate Government departments.



Butane/air plant at the Hereford works of Henry Wiggin & Co. Ltd., showing some of the storage vessels, with the four vaporisers in the foreground.

A report on the conference on "Getting the Best out of Coal," held by the **Combustion Engineering Association,** at the Hotel Majestic, Harrogate, on November 8th and 9th, 1960, is now ready and can be obtained, price £1 0s. 0d., post free, from:—The Combustion Engineering Association, 70, Jermyn Street, London, S.W.1. Following an opening address by Dr. C. M. Cawley, Chief Scientist, Ministry of Power, papers by leading authorities in their several subjects examine from both the technical and economic aspects, the choice of coal allied to the selection, operation and maintenance of equipment for boiler plants and industrial furnaces and kilns, in order to achieve the maximum savings in capital and operating costs. Ample time was allowed for discussion at the conference and these discussions are fully reported. This 205-page report will be valuable as a textbook for all those concerned with the efficacious use of solid fuel in industry.

* * *

Foster Wheeler Limited, and **John Brown Land Boilers Limited** have formed a consortium to be known as **"Foster Wheeler-John Brown Land Boilers Consortium,"** and which will carry on as a joint venture, the business of tendering for and executing contracts to be placed by, and on behalf of, public authorities in the United Kingdom and Eire for power station boiler plant and ancillary equipment.

New Sulzer Process Engineering Laboratory

WE have recently received from Sulzer Brothers Limited, details of the new process engineering laboratory which this famous engineering firm has provided at their works at Winterthur. It is generally recognised that the multifarious problems of process engineering cannot be solved unless the extensive theoretical study which they incorporate is supplemented by experimental work. Sulzer Brothers have now provided the equipment needed for this, in the new laboratory which has been designed for the widest possible use and allows for easy extension when required. The laboratory contains a number of fixed installations, such as rectifying columns, and also possesses facilities for the erection and testing of pilot plants.

The intensive work with which the firm has been concerned in recent years in the process engineering field involves a growing amount of experimental work, part of which must be on an industrial scale, and demanding constantly expanding facilities for the erection of pilot plants. Whilst the process equipment branch, from which the present process engineering section has been formed, was primarily concerned with the design and manufacture of single units of equipment, the present intention is the planning of complete plants for any particular purpose, such a plant to be capable of

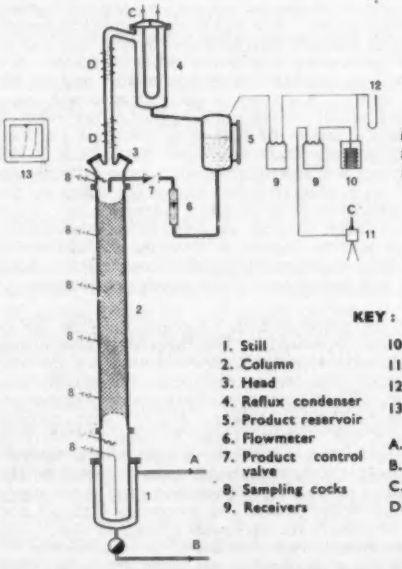


Fig. 1. Diagram showing arrangement of column.

turning out a given product continuously and at a consistent quality level, and must be designed for optimum economy.

Sulzer Brothers are, of course, in a position to draw on their wide experience in many fields—heat engineering, high- and low-temperature techniques, control systems, and the application of stainless materials—and, furthermore, have had available the results of work carried out in their well-equipped central laboratories. It was decided, however, that a process engineering laboratory was necessary if the special problems met with in this field were to be studied in detail. The new laboratory will serve many purposes: it will be used both for basic research, and for the erection and testing of pilot plants of many different types. At the present time, special importance is attached to the carrying out of rectification tests with Kuhn columns under favourable operating conditions. As these tests occupy long periods of time, truly productive research is only possible when several columns are available.

The new laboratory has been designed to be as nearly universal as possible. The permanent or fixed floors have been kept to a minimum; but other floors can be moved or adjusted to suit changing requirements. Equipment up to 20 m. (60 ft. 6 in.) in height can be accommodated in the enclosed building, which means that columns of sufficient length for most experimental requirements can be erected. In any exceptional cases, columns can also be carried to a height exceeding roof level.

Within the building an effective air treatment system has been provided to allow work to be done with highly volatile and explosive substances, and the permanent electrical equipment has been made explosion-proof for the same reason. If necessary, the temperature of the building can be kept constant. Separate supplies of electricity and water are provided in order to permit prolonged tests to be conducted without danger of interference, while the requisite steam heating requirements are provided for by a separate boiler.

The experimental rigs will be assembled in the large hall, while in addition to this there are several separate rooms, such as a storage section, a room for the electrical distribution equipment and voltage stabilisers, a laboratory for chemical investigations, a low-temperature room with a refrigerating machine, a ventilating fan chamber for the treatment of the air, and an office.

The apparatus used, naturally depends to a large extent on specific requirements, but at present, the following basic equipment is installed. There are rectifying columns, the principal object at present of these being to determine the most suitable packings for various separation problems. This involves: determination of the specific number of stages that can be attained, as it is on this that the height of the column depends; measurement of the maximum throughput, which fixes the cross-section of the column; calculation of the minimum packing volume, which substantially affects the price of the column; establishment of the dependence of the specific number of stages on the tube diameter.

The purpose of these investigations is to provide a basis for the optimum planning of rectification equipment, and to permit a guarantee to be offered in respect of column capacity and purity of the product. In most cases, a rectification test has to be carried out with the mixture submitted by the client.

The diagram in Fig. 1 shows the column arrangement

used for tests conducted in connection with the difficult separation of heavy water. It is usual in these tests to use ordinary water and to measure the H_2O^{18} content with a mass spectrometer. The columns are fitted with sampling cocks at various heights to permit the distribution of the concentration over the full length of the column to be determined. The temperatures are recorded automatically. The throughput is set with the product rate control valve, which fixes the reflux, the column operating with total reflux. It is also intended to instal columns permitting operation under continuous feed conditions.

The great advantage of the Kuhn column is that tests can be carried out in a single tube with a comparatively small amount of substance, and that the results obtained in this way can be transferred quite satisfactorily to an industrial column with several tubes.

Fig. 2 shows a few single-tube columns of various lengths. In the short columns the equilibrium times are not unduly long, while in the long columns operating conditions in plants of industrial dimensions can be investigated thoroughly.

Fig. 2 (left). Examples of single-tube rectifying columns of various lengths.

In the washing room, components received direct from the works are washed and all traces of grease removed. An installation for the activation of packings is also located in this room. It has been proved that the surface finish of packings has a marked influence on the rectification process; many surface activation experiments have, therefore, been carried out in the Sulzer laboratory, and an installation has now been erected in which the packings for industrial columns can be treated. Capillaries are used to ensure uniform flow to all the tubes of a Kuhn column. These capillaries must have an exact, predetermined resistance, and a calibrating installation is provided for ensuring this.

The semi-industrial laboratory column will be used chiefly for determining the components of unknown mixtures. Tests will, of course, also be conducted to check the adequacy of the design, and mixtures will be rectified to suit clients' requirements. An extensive programme of tests has been drawn up for the molecular distillation equipment, and it is hoped that the results will lead to a design suitable for universal use. The chemical laboratory has been fitted out to enable various types of work connected with the tests to be done on the spot. This will consist of concentration measurements and simple analyses, while more extensive investigations can be conducted in the main chemical laboratory.

A Philips low-temperature refrigerating machine is housed in a separate room (Fig. 3), so that low temperatures can be produced in the building. These will be needed for tests connected with the design of Sulzer low-temperature plants and the materials used in them, and they will also enable low-temperature rectification tests to be carried out. Finally, they will be useful for freezing out certain components in gas analyses. Many design tests will also be necessary, for instance, with evaporators, liquid distributors, valves, measuring devices and high-vacuum components. Some long-duration tests are also envisaged, and are, in fact, now being carried out on a pump for special duties and on high-speed bearings. A particular field of research will be the further development of expansion turbines. These are important in low-temperature installations, for instance, in the expansion of hydrogen for refrigeration plants at temperatures down to about — 250 deg. C. (—418 deg. F.). Absorption tests, which hitherto have had to be conducted at various different points, will also be centralised in this laboratory.

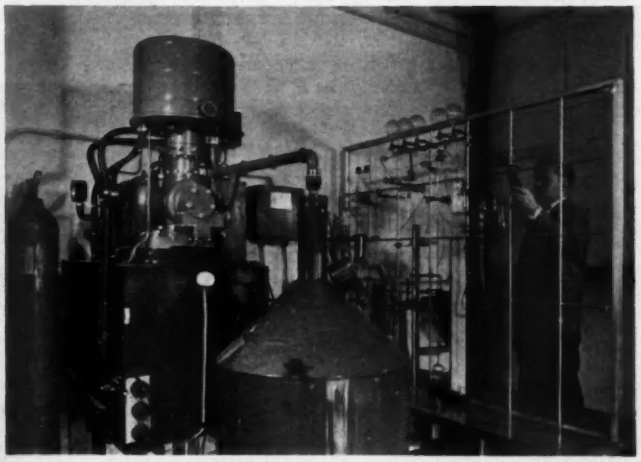


Fig. 3 (above). Part of separate room containing a Philips low-temperature refrigeration plant.

The requisite theoretical work will naturally have to be done parallel to these varied tests, and will be entrusted to scientists specialising in a variety of fields, such as process engineering, physics, chemistry, mathematics, mechanical and electrical engineering.

With this new laboratory to reinforce the firm's wide range of design and manufacturing facilities, Sulzer Brothers look forward with confidence to their future tasks in the process engineering field.

Production of Improved Heat Insulation Material

BY courtesy of the directors of The Chemical & Insulating Co. Ltd., we recently paid a visit to that company's extensive works at Darlington, in order to see first hand, the modern production methods adopted and also to see the results of recently-introduced facilities there to allow for increased production. The Chemical and Insulating Co. Ltd., is the chief manufacturing company in the Darlington Chemicals Limited Group of Companies, which comprises three major operating companies and a larger number of smaller ones, manufacturing, selling and contracting mainly in the field of insulation, and in fields technically related thereto.

The Chemical and Insulating Company is, in effect, the centre from which the activities of the other companies have grown and developed, and it is this company's manufacture of thermal insulating materials that provides the main link with the other companies in the Group. It led to the creation of a contracting department, which in time became completely independent, and known as The Darlington Insulation Co. Ltd., now claimed to be the leading insulation contracting organisation in Great Britain, with branches in all the major industrial areas. The third main company in the Group is Darchem Engineering Limited, whose formation was due to the urgent need which arose in the 1950's for a very light and efficient high-temperature insulation to protect aircraft structures from the great heat of jet engine exhaust gases. This was found in Refrasil, a virtually pure silica fibre with several unique advantages for high-temperature insulation. For use in jet aircraft, it is necessary to encase the Refrasil material in a stainless-steel foil envelope, accurately shaped to fit the component to be insulated, and precision-welded.

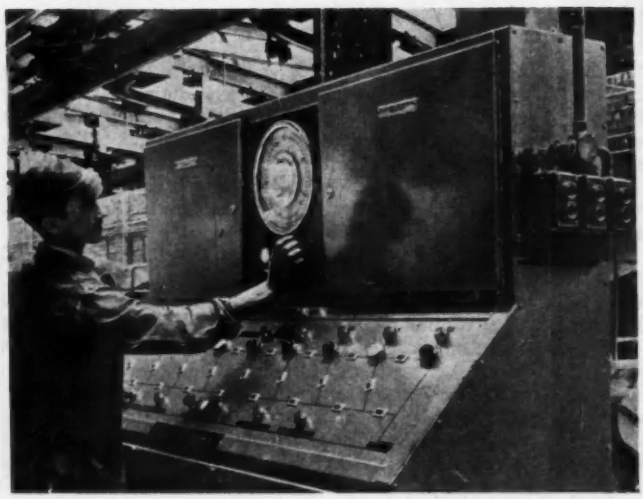
The Refrasil material is manufactured by The Chemical and Insulating Co. Ltd., at Darlington, while the engineering work is carried out by Darchem Engineering Limited (formerly The British Refrasil Co. Ltd.), at Stillington, about 10 miles from Darlington. Darchem Engineering Limited has accumulated a great store of experience in fabricating and welding thin stainless-steel sheets, and the special skills that have been developed, have led into a number of fields not directly connected with insulation, but in which the company carries out a wide range of engineering work.

Of the other companies in the Group, S. T. Taylor & Sons Ltd. is an old-established firm of plate and sheet-metal fabricators and engineers, which has recently merged with Darchem Engineering Limited (and is carrying on its business from Stillington), and Dust Control Processes Limited, formed to design, develop and manufacture dust-control equipment for industry.

The Chemical & Insulating Company's main range of products includes Magnesia Chemicals, Magnesium Carbonate, Oxide, and Hydroxide in both pharmaceutical and industrial grades. Insulation products are 85 per cent. Magnesia, 85 per cent. Super Magnesia, Metadextramite, Dextramite and Paratemp.

For many years, the standard heat insulation material for all normal industrial purposes has been 85 per cent. magnesia—a combination of 85 per cent. of light basic magnesium carbonate with 15 per cent. of long fibred asbestos, mixed and filter-moulded into preformed pipe sections and slabs. The company has been making 85 per cent. magnesia insulation, together with a range of insulants for higher temperatures, finishing materials, and magnesia chemicals, since 1929, when the present works were built at Darlington, to extract magnesium compounds from the dolomite limestone that underlies large areas of County Durham. It is the magnesium carbonate, in the form of feathery crystals with large numbers of entrapped air-cells, which is used for insulating purposes. During recent years, the company has carried out an intensive research programme into ways of improving 85 per cent. magnesia so as to maintain its supremacy over other products. The result of the programme is the production of Darlington 85 per cent. super-magnesia, which is made by a new manufacturing process, developed especially for the product.

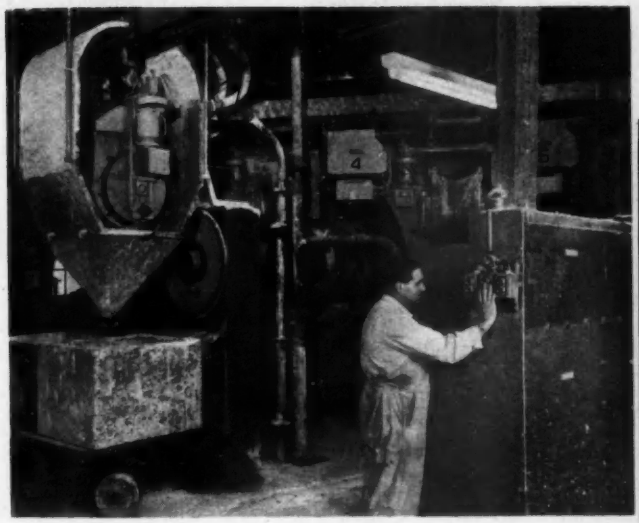
The chief characteristic of 85 per cent. super-magnesia is that, instead of being merely held together by the reinforcing effect of the asbestos fibre content, it is chemically bonded together: the crystals "grow round" the asbestos fibres to give a product of high



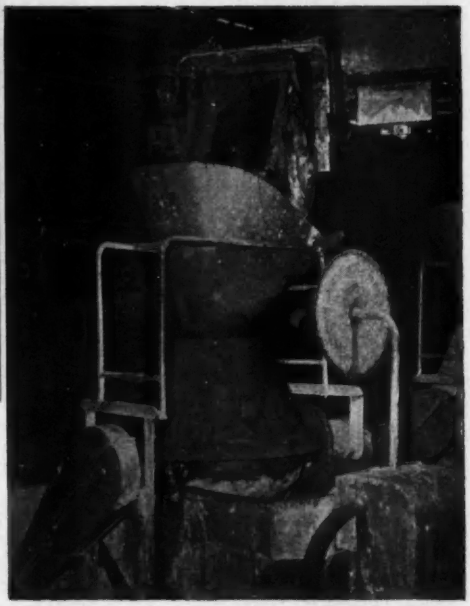
One of the two master control-panels, which automatically control the weight of suspension (slurry) which is pumped to containers travelling on a British Mono Rail conveying system.

mechanical strength, high resistance to vibration, and high retention of shape after wetting. These qualities, added to the fundamental advantages of magnesia, have been welcomed by insulation material users and contractors, and have led to the increased use of magnesia in some applications where there had been a tendency towards cheaper materials of different types. The moulding process, which is a very accurate one, ensures that each piece is perfectly formed and that pipe sections make an exact fit over the pipe which requires insulating. Like all Darlington insulating materials, 85 per cent. super-magnesia is rot-proof, odourless, fire-proof, and incapable of corroding metals or harbouring pests.

Darlington Paratemp, which is a calcium silicate insulation intended for a higher temperature range than that for which 85 per cent. super-magnesia is suitable, is similarly bonded together, and has equal strength characteristics and resistance to vibration and wetting.



(Above). *The automatic weighing plant by which the slurry is distributed in accurately-measured quantities to the preheaters.*



(Right). *Automatic discharge of 85 per cent. super-magnesia slurry from mono-rail hopper to one of the preheaters.*

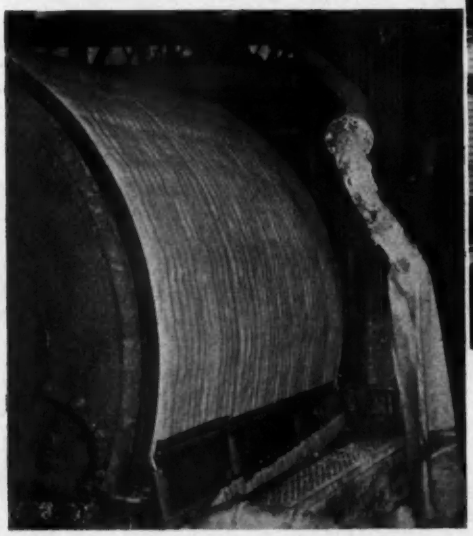
It is made by the same precision-moulding process, makes a perfect fit, and has a very superior finish. Whereas 85 per cent. super-magnesia is claimed to be the best insulating material available for temperatures up to 650 deg. F., Paratemp, which is slightly more expensive, is more suitable for temperatures between 650 deg. and 1,400 deg. F.—for instance, as a hot face layer with an outer layer of 85 per cent. super-magnesia.

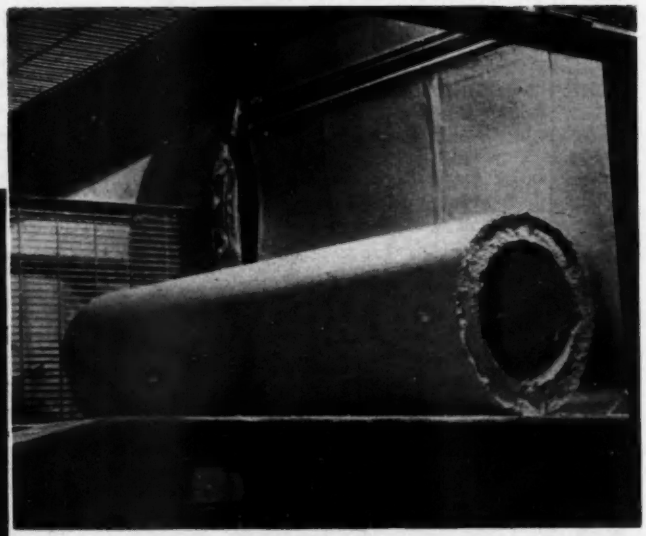
Both Darlington 85 per cent. magnesia and 85 per cent. super-magnesia coverings for preformed pipe sections are made in thicknesses of 1 in., 1½ in. and 2 in., for all sizes of pipes from ½ in. to 8½ in. outside dia. Filter-moulded sections are also made in thicknesses of 2½ in. and 3 in. for certain pipe sizes. For the insulation of pipework between 8½ in. and 30 in. in dia., radiused slabs are normally used, these being available in sizes up to 36 in. × 12 in., and in thicknesses of 1 in., 1½ in. and 2 in. (super-magnesia) and in 1 in. to 4 in. (filter-moulded). Both flat and radiused slabs are supplied in these thicknesses, radiused slabs being available in super-magnesia up to 2½ in. thick.

Dextramite was specially evolved by the company to meet the demand for a product combining efficient heat insulation with chemical inertness and the ability to withstand continuously temperatures up to 2,000 deg. F. Besides fulfilling all these requirements, Dextramite possesses a relatively high degree of mechanical strength. Metadextramite has been developed to withstand temperatures of the order of 1,625 deg. F., and is thus suitable for use on modern superheated steam plant and equipment. The properties particularly important in this field, namely, low bulk density and low thermal conductivity, together with good mechanical strength, are also met by metadextramite. Dextramite and metadextramite coverings, sections, slabs and plastic are available in all the many sectional and slab forms and sizes in which 85 per cent. magnesia is produced, as well as in a corresponding plastic form. For the latter, the covering capacities are for Dextramite 900 and for Metadextramite 1,350 sq. ft. per ton for 1 in. thickness. Paratemp Calcium Silicate insulation was specially developed for the petroleum and chemical industries, but it is ideally suited for application in many other industries. It is a "one-piece" insulation, and can be applied direct without an initial hot-face layer in the temperature range of 200 deg. F. to 1,400 deg. F.

The manufacturing process of Darlington, 85 per cent. super magnesia involves the hydraulic setting of magnesium carbonate crystals in a mixture with asbestos fibres during heating under controlled conditions. The crystals are prepared under controlled conditions of temperature and agitation from magnesium bi-carbonate solution.

An alternative method is to carbonate magnesium hydroxide suspensions using carbon-dioxide gas under controlled conditions of agitation, temperature and concentration. The resultant suspension, containing magnesium carbonate trihydrate crystals (which are needle-like crystals of average size of 30 microns by 7 microns) is filtered on a rotary vacuum filter to remove water. The wet cake is removed continuously to a mixing tank, containing water and asbestos fibres, where the entire mass is agitated at a controlled speed to produce a uniform mixture. The amount of water added during mixing determines the density of the final dried product. After mixing, the suspension is pumped via an automatic weighing device to a container travelling on a British Mono Rail system. As each empty container reaches the filling station, an inter-connecting air-operated solenoid valve permits the suspension to flow into the container until the predetermined weight limit is reached. The container is then despatched along the mono-rail system to the appropriate preheater unit, which is waiting to be filled. The preheater, which is a revolving mixer of concrete-mixer type, remains in the vertical position when empty, and the travelling container discharges the suspension into it via a hopper chute. Each preheater supplies one moulding station. When a preheater receives a charge of suspension, a red light shows at the appropriate moulding station to warn the operator that the system is ready for him to initiate the next cycle by pressing the button that will start it. This he will normally do when the pieces from the previous moulding operation have been ejected, so that the first part of the cycle can be going on while he is clearing the mould. In the first part of the cycle, the preheater starts to rotate and tilts to a pre-determined angle. At the same time, a steam injection system fits on to the revolving mouth of the preheater, steam being passed through the suspension for a time sufficient to raise its temperature to approximately 120-130 deg. F. At the same time, the mould filling assembly which is connected to the outlet hopper of the preheater, descends to the mould surface. The filling assembly is equipped with finger agitators which help to fill the suspension into the moulds and at the same time eliminate air bubbles in the suspension, while the mould cavities themselves are accurately machined in a heated block and have pistons sliding in them. When the suspension is sufficiently preheated, the steam supply is automatically cut-off and the injection system returns to its static position. The preheater then tips the heated suspension via the chute into the mould hopper, the pistons begin to withdraw, and the suspension, aided by the finger agitators, flows into the mould cavities. The preheater returns to the vertical position and stops, while the finger agitators retrace their movement and the complete filling assembly returns to its upper station. The mould cavities are heated by circulating water at high temperatures, and the suspension is rapidly converted into a solid mass. As the last stage in the moulding cycle the pieces are pushed out by the pistons and lifted on the bogies for drying.





(Above). An 85 per cent. super-magnesia section about to enter an automatic end-trimming and longitudinal-splitting machine.

(Left). A rotary vacuum filter discharging 85 per cent. super-magnesia as filter cake prior to further processing.

The bogies, loaded with moulded pieces, are then passed through drying tunnels on a semi-continuous basis. After drying, the pieces are removed for trimming and, in the case of pipes, for splitting into two equal parts. After these operations, the pieces are packed into cartons for storage and/or despatch. The off-cuts from the machining operations (which are much smaller than those from the extensive machining required by filter-moulded insulation) are crushed and the resultant fibrous powder is bagged for sale as plastic insulant. The plastic is mixed with water to a plaster-like consistency and is used for covering irregular or awkwardly-shaped surfaces, or for other special requirements.

Darlington Paratemp calcium silicate

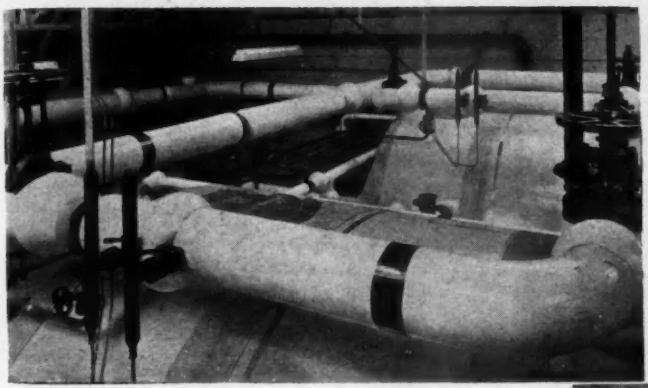
The raw materials required for the manufacture of calcium silicate insulation are based on hydrated lime, silicious constituents, and asbestos fibre, with some colouring matter to distinguish the finished product from 85 per cent. super-magnesia. These materials in the correct proportions are mixed with water and agitated under controlled conditions to a uniform suspension. Again, the amount of water added controls the final density of the product. From the mixer, the moulding cycle is exactly the same as for 85 per cent. super-magnesia, except that the temperatures for pre-heating and mould heating are higher. After the pieces have been ejected from the moulds, further treatment is required to complete the formation of the correct calcium silicate crystals—autoclaving under high-pressure steam conditions—after which drying, machining and packing are the same.

The Darlington works employ about 400 workpeople, comprising some 200 male workers engaged on production, either day-work or shift-work, about 100 female production workers who are engaged on day work, and about 100 maintenance workers. The works output of finished products is upwards of 200 tons per week—this total being equally divided between chemicals and insulation materials.

In the manufacture of insulation materials by the new process which the company have adopted, it is necessary in order to produce 100 tons of finished products to mould about 110 tons of material. But in the old process about 200 tons of material had to be moulded in order to produce 100 tons of finished products. The recent increase in moulding capacity on the insulation side has been made to meet the increasing demands for 85 per cent. super-magnesia, and also for Paratemp, the new high-temperature calcium silicate insulation material. On the chemical side, new equipment has recently been installed to increase the production of Darlington light magnesium oxide, the sales of which for use in Neoprene compounding are expanding in Europe and the U.S.A., as well as in the home market.

The works steam load demand is supplied from the company's own boiler plant which comprises five Babcock W.I.F.—type stoker-fired units—three each of 12,500 lb./hr. and one of 50,000 lb./hr. capacity. The total boiler output capacity is thus 97,500 lb./hr. The average coal consumption is 450 tons per week. Water requirements for process work total about 3 million gal. per day.

Although it began its career by taking over the contracting department of the Chemical & Insulating Co. Ltd., The Darlington Insulation Co. Ltd. has been an independent company for many years, during which it has made a specialised study of insulation problems, and as a result, is in a position to offer industry a complete scientific service aimed at reducing to a minimum, the losses in profits and production caused by heat losses. Insulation work is carried out either to the customer's specifications, or it can be designed specifically by the company, who claim that there is no type of industrial insulation work that it is not prepared to do. Probably the most outstanding examples of insulation work carried out by The Darlington Insulation Company are to be found in some of the most modern and recent power stations—which provide perhaps the severest tests of insulating materials and their correct application. The company has also carried out a large amount of insulation work in nuclear power stations, large industrial power plants, oil refineries, chemical plants, etc. and insulation work in ships of many different types.



(Left). Part of a typical installation showing boilers and steam pipes insulated with 85 per cent. super-magnesia slabs and sections finished in armouring compound A.C.1.

(Below). Example of metal protected insulation work carried out by The Darlington Insulation Co. Ltd. on the reactor pressure vessel at a nuclear power station.

Refrasil

Earlier in these notes we made reference to the Refrasil insulation material which is manufactured by the Chemical & Insulating Co. Ltd., at Darlington, while the engineering and metal work concerning the application of Refrasil is carried out by Darchem Engineering Limited at Stillington, which works we also had the opportunity of visiting. Refrasil is the name given to a lightweight fibrous silicate material with a SiO_2 content of more than 96 per cent. It has outstanding thermal insulating characteristics at high temperatures (it is able to withstand continuous temperatures of 1,000 deg. C., and intermittent temperatures a good deal higher) and is, in addition, an excellent high-temperature electrical insulant. For most practical purposes, it may be regarded as a flexible equivalent of solid fused silica. It possesses the same qualities of higher resistance to thermal shock and acid attack. Refrasil is available in the form of bulk fibre, batt, cloth, tape, sleeving, cordage and yarn. Originally developed to overcome problems of insulation in jet aircraft, it is now used for a wide variety of purposes. For aircraft application, the batt is enclosed in specially-designed stainless-steel envelopes to form an accurately-fitting easily-removable blanket, and in this form it has had great success as an insulant for all forms of gas turbines for both land and marine use, as well as for aircraft. Refrasil is also used as a filter medium for removing dust and other particles from high temperature gas streams. Its high temperature resistance makes it impervious to the heat of the gas, while its chemical inertness renders it of special value, since it neither reacts itself, nor promotes reaction among the elements and compounds trapped in the filter. Refrasil is used as a flexible backing between bricks lining a furnace wall, where allowance has to be made for expansion. Refrasil batt has a bulk density of about 4 lb./cu. ft., but can be compressed to a maximum of 9 lb./cu. ft.

NUCLEAR CLEAN WORKSHOP

Recently we received from **Stewarts & Lloyds Limited,** details of a special shop which has been built at the company's Tolcross Works, in Glasgow, to provide "nuclear clean" conditions required for the assembly of reactor components, by the pipework engineering division of the company. This shop has a floor area of some 7,000 sq. ft. and has been erected at one end of the main works building where the components are fabricated. At present it is primarily engaged in the manufacture of 424 nuclear reactor control-rod standpipes—which were designed by The General Electric Co. Ltd., and ordered by the Motherwell Bridge and Engineering Co. Ltd., for the Hunterston Nuclear Power Station now being constructed by the G.E.C.-Simon-Carves Atomic Energy Group. Each of the standpipes being supplied to this order is 32 ft. long and incorporates 63 tubes assembled to within very close tolerances of straightness with cavities filled with high-density barytes concrete which acts as biological shielding. As with all other reactor components, these standpipes must be assembled under scrupulously clean conditions in order to ensure the absence of any of the elements present in dirt and dust particles which could damp down the reaction and also make the gas-stream radio-active.

The procedure followed at Tolcross Works to ensure the required standard of cleanliness comprises the degreasing, shot-blasting and vacuum cleaning of the components. This is followed prior to assembly by the application under dust-free conditions of a protective coating to prevent rusting. The protective coating used needs to be of a material which does not have any undesirable effects under heat or irradiation, and the three liquids generally used at this plant are "Trilac" or clean conditions primers "P.A. 20" or "P.A. 21." The new shop is of dust-proof construction with double-glazed windows, and its doors are rubber-edged to provide effective sealing. Specially-surfaced floors eliminate dust formation, and the walls and ceilings, designed for easy cleaning and free of dust-holding recesses, are finished with a gloss paint free of any constituents likely to contaminate the products. An air-filtration plant, designed and installed by Solano Air and Heat Systems Limited, maintains slightly pressurised conditions to prevent the ingress of contaminated air from the outside atmosphere. The filtered air is temperature controlled, and is stated to exclude dust particles down to 1 micron from the volume delivered into the shop. All personnel working in this section wear white overalls, caps, gloves and rubber boots, while dust-sealed changing rooms are provided in one corner of the shop.

Under the manufacturing procedure, all parts as they are completed on the lines in the main fabrication shop are degreased and, after drying, delivered into a large shot-blasting chamber. From this chamber, the components are passed into a vacuum-cleaning chamber which, through sealed doors, has direct access into the dipping and preparation section of the "clean shop." The parts are transferred from the vacuum chamber by an overhead monorail system fitted with 2-ton capacity hoists which serves the whole floor of the clean shop. Dipping of the components to apply the protective coating is effected as quickly as possible after shot-blasting and vacuum cleaning to ensure that there is no time lapse for rust formation. After draining over the dripping tank, the parts take about one hour to dry before they are transferred to a system of rubber-lined skids in the assembly shop. The layout of the shops and their capacity provides facilities for the assembly and manufacture of a wide variety of reactor components as well as other products calling for "clean" conditions. We are informed that now it has these new facilities the firm is taking on an increasing amount of work requiring the special conditions on a sub-contract basis from other companies.

HINKLEY REACTOR PRESSURE-VESSEL PASSES TEST

The No. 1 reactor pressure-vessel at the C.E.G.B. Hinkley Point atomic power station, was successfully pressure-tested on February 18/19th, at the highest pressure so far produced in vessels of this kind. The operation was carried out without a hitch, and was completed six hours ahead of schedule. The pressure vessel, a 67 ft. dia. sphere, built by Babcock & Wilcox Limited, from 3-in. thick mild-steel plate, is the largest ever to have been tested on site and it successfully withstood a pressure of 310 lb./sq. in., which is more than 1¼ times the pressure it will have to stand in service. Over 3¾ million cu. ft. of free air was pumped into the vessel to achieve this pressure. The sphere was pressurised in stages, the highest pressure being reached during the early afternoon of February 19th. Special driers were used to remove the moisture from the air before it was pumped into the vessel, and the temperature of the sphere was also raised to 86 deg. F. to ensure that the inside was perfectly dry. The vessel will now be subjected to a vacuum test, in which the air will be pumped out. More than 20 miles of special cored wire were used to connect the 274 strain gauges and the thermocouples that were fixed inside and outside the vessel to record the stresses and temperature readings. Normally, pressure-testing of vessels of this nature is carried out at the manufacturer's works, but pressure-vessels for nuclear power stations have to be built up in sections and welded together on site, since they are too large to be transported from works to site as a complete unit. In order to ensure complete safety of personnel, the tests were conducted during a week-end when the site was free of the 1,500 workmen and administrative staff. The 40 or so technicians supervising the operations were housed in temporary accommodation in the adjacent second reactor building. An elaborate system of telephone communications between a central control and key points maintained a smooth continuity throughout the 48-hour test period. The station, which is being built for the C.E.G.B., by The English Electric, Babcock & Wilcox, Taylor Woodrow Atomic Power Group, will be of 500-MW capacity, and the first reactor is scheduled to go into service next year.

New Electronic Computer for Industrial Applications

RECENTLY we were invited to visit the headquarters of the computer sales organisation of Ferranti Limited, in Newman Street, London, W.1—this organisation being responsible for the sales of the whole range of Ferranti computers. The company has lately received two major contracts for the supply of Argus computer control systems. The first of these will be of great interest to the chemical industry, as it marks a turning point in the utilisation of the electronic computer in this country, in that it extends its role from that of a passive instrument, to an active means of control. Thus it is the first example in this country of a computer to be put in direct control of a large chemical plant. It has been ordered by Imperial Chemical Industries Limited, for one of their chemical plants at Fleetwood, Lancs., where it will take over the functions of about 100 conventional control devices.

The second order for an Argus computer has been placed with Ferranti Limited, as the result of the combined initiative of two other great organisations, viz:—the Central Electricity Generating Board and Babcock & Wilcox Limited. This order covers the supply of a computer control system for the starting-up, operation, and shutting-down, of a Babcock 1,350,000 lb./hr. capacity boiler unit which will steam a 200-MW turbo-alternator set at the Generating Board's new power station now being constructed at West Thurrock, Essex, and is also the first installation of its type in this country.

Fig. 1. Main unit of the Ferranti "Argus" process control computer. The machine has been designed for use in industry and uses solid-state components throughout.

Process-control computer system

In recent years, there have been fundamental changes in the characteristics of industrial plants and processes, and in the functions of those people who operate them. Plants have become larger, and processes enormously more complex, so that very difficult control problems are constantly arising. The functions of the operators of many processes are now largely supervisory, the actual plant operation being governed directly by some form of automatic, often analogue, control system under the operator's command. Meanwhile, the digital computer has come into use as a research tool in designing new plant, and digital techniques are being widely used for data logging and alarm systems. The next stage in the evolution of process control has been made possible by the latest advances in electronics, thermionic valves and electro-mechanical storage elements being replaced by much more reliable devices such as transistors and ferrite cores. The application of these techniques permits the supervision of plant control systems by means of computers, or even the direct control of the plant, with a consequent improvement in the efficiency of the process and in the flexibility of control.

With an already well-established reputation in the field of digital computers generally, and with a long background in the design of specialised control systems, Ferranti Limited have now produced "Argus," a digital computer designed specifically for process control. The special features necessary in a computer intended for work of this kind have been included from the start. It should be emphasised that "Argus" is not just an adaptation of a general purpose computer.

No control equipment will ever be 100 per cent. reliable, but it is possible to provide a computer controlled system which is self-checking, and so organised that the consequences of rare failure, either in the computer or the associated instruments, is likely to be much less serious than in the case of manually-controlled plant.

A computing system such as the "Argus" is not cheap, and there are certain pre-requisites for the application of such a computer system to a process: viz—(a) There must be an economical gain potential which will more than pay for the computer installation. This implies that the installation is so complex that operation at the optimum is beyond reasonable unaided human capability and that the value of materials processed is great. (b) The measurement and instrumentation techniques of the process must be so highly-developed that it becomes possible to understand the major factors governing its behaviour and bring them under automatic control as dictated by the calculations continuously performed by the computer. In many cases at present under study, this is not established, and it is necessary to engage in improved instrumentation and data logging activities to provide a sound basis for a computer system

proposal. As regards the point concerning economic gain potential, it should be realised that computer control systems may cost anything between £20,000 and £100,000. Improvements may be only a few per cent. above that obtained with human operators, but on a large plant this may be more than sufficient. For example, in a large works producing sheet steel, the annual output may be worth £100 million. The amount of material being re-circulated due to lack of control of thickness, width, etc., may be as high as 20 per cent. The value of re-circulated material may be £10 million per annum, so that reduction of the 20 per cent. to 19 per cent., would yield £500,000 per annum. Control

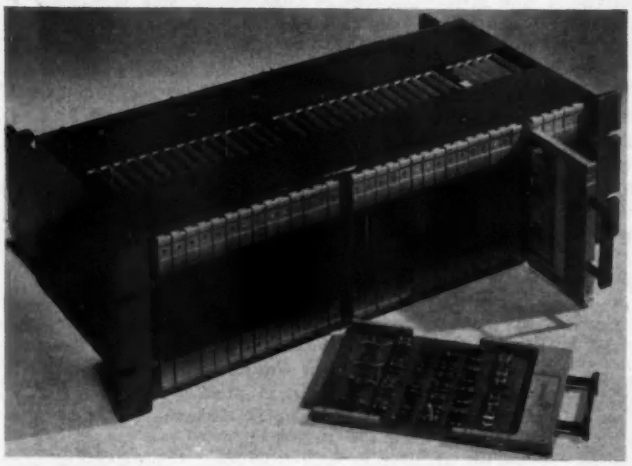


Fig. 2. Circuitry of the Ferranti Argus progress control computer is mounted on printed-circuit packages which plug into boxes. Each box holds 36 packages.

of a single factor, like the width of the strip, might alone yield this kind of saving. The scope is enormous but the "know how" stage is only just being reached. There is also the possibility of using one computer to control several process units by time-sharing techniques.

Applications

The use of a digital computer for process control shows immediate advantages in flexibility and in the degree of sophistication of control that can be achieved. Flexibility arises naturally from the fact that the computer is a programmed instrument; that is, a programme of instructions detailing the computation and logical operations to be carried out is stored within the computer and can easily be altered or expanded. Sophistication is linked with this, in that there is no necessity for restriction to linear control systems, so that simple forms of control can be chosen initially and improved upon later in the light of experience.

The range of applications for the "Argus" computer is very wide. Where existing controllers are already in use—as in all kinds of chemical processes, whether continuous or batch production—significant improvements in consistency of control can often be achieved. There are also applications in fields where no adequate form of control has yet been developed, in which the handling of logic is as important as the manipulation of numerical information.

For those who are unfamiliar with digital computers, a word of explanation may be helpful. Any computation that has to be performed must be broken down into a programme, which is a sequence of elementary instructions, each of which is usually an arithmetical operation such as addition or multiplication. The programme is stored within the computer, which can, therefore, repeat (or alternatively ignore) some sections as required; the decision for such a repetition is made, for example, on the result of a computation. Writing programmes for any computer is necessarily a specialised skill, and Ferranti Limited employ a large staff or programmers to advise and help customers at any level. Numbers within the computer are held in binary form, so that successive digits represent powers of 2, as opposed to powers of 10 in decimal notation. Each binary digit or "bit" can only have two values, 0 or 1 (contrast 0 to 9) which is convenient for purposes of design. Temporary storage is provided for intermediate results of computations, one number occupying one location in the store. The greater the number of bits, the more accurate the computer; one decimal place corresponds to about three bits. Each instruction is stored in the computer as a set of binary numbers which are decoded before the instruction is obeyed.

Details of the I.C.I. installation

The "Argus" digital computer was designed with the control of industrial processes specifically in mind; the electronic circuits are constituted entirely from solid state components. The machine uses binary serial/parallel fixed-point arithmetic and a word length which may be either 12 or 24 bits. On 12-bit numbers, addition is carried out in 20 microseconds, multiplication in an average of 100 microseconds and division in 200 microseconds. Programming the machine is carried out manually, by inserting small ferrite pegs into holes drilled in printed circuits arranged in trays, the latter forming the programme stores. Reading-out of the stored information is done by energising the printed conductors on one face of a tray, and the pegs cause currents to be induced in certain of the conductors on

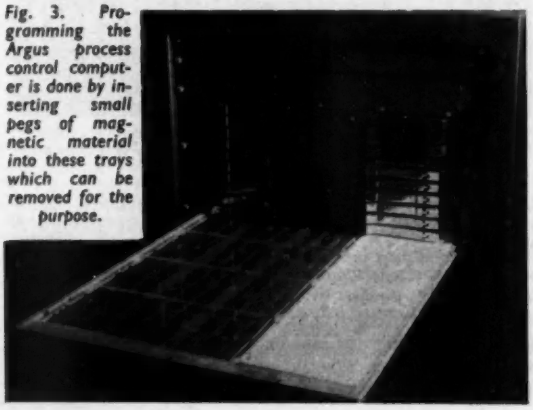


Fig. 3. Programming the Argus process control computer is done by inserting small pegs of magnetic material into these trays which can be removed for the purpose.

the other face, depending on the pattern in which the pegs are inserted. The high-speed working store is a magnetic-core matrix. Backing-up storage of 50,000 words can be provided by magnetic drum. One special feature of the machine is a facility which enables the main programme to be interrupted at regular intervals to allow a special routine of instructions to be carried out—as may be required for regularly examining some quantity in the controlled process and taking necessary corrective action. Another facility allows for direct writing into or reading out of the magnetic-core store by independent equipment, such as magnetic tape units, which cannot be synchronised with the computer. Peripheral equipment available enables all types of electrical signals to be selected and converted to binary form.

When the installation of new instruments at the I.C.I. plant became necessary, it was decided to centralise all the control loops in a digital computer rather than to install a large number of individual analogue controllers in a conventional system. The installed price of the digital control system is slightly higher than that of the conventional analogue system but the central availability of all process data in the former offers many benefits which could not otherwise be achieved. For example, the process variables will be logged on magnetic tape in such a way as to facilitate mathematical analysis of the plant characteristics on a Ferranti Mercury computer (until recently one of the fastest digital computers in Europe). The knowledge gained in this way will gradually be incorporated into the "Argus" programme so that, ultimately, the independent control loops which are built into it will be subject to overall supervision by a master section of the programme.

As previously stated, about 100 individual control loops will be replaced by the "Argus" computer, which will have a programme capacity of 1,024 instructions and core storage for 1,024 words. Over 300 analogue signals of six different types are to be read in—one group of 100 points being selected in a total time of $\frac{1}{10}$ sec. Outputs for controlling the settings of nearly 100 pneumatically operated valves are also being provided. The fact that the computer operates directly on the process is the most important feature of this application. A more orthodox approach would have been for the computer to operate through the agency of conventional controllers, or in parallel with them, to guard against the possibility of equipment failure. The reliability of the "Argus" equipment, however, coupled with the docile nature of the I.C.I. process, makes such precautions unnecessary. The individual computing elements from which the "Argus" is built up are versatile units constructed as printed-circuit packages, with 36 packages in a box (Fig. 2). These boxes can, in fact, be assembled very quickly to form different types of digital control systems.

COMPUTER FOR BOILER CONTROL

The decision to provide a computer for use in connection with the control of the Babcock No. 2 boiler at West Thurrock power station, follows a lengthy study by a group appointed by the C.E.G.B., and follows the installation of the first automatic electronic boiler control system in this country, viz., at Little Barford "B" power station (see *Engineering & Boiler House Review*, March, 1960). This system, which was supplied by Evershed & Vignoles Limited, comprises single-analogue on-line computers and three-term electronic process controllers which regulate control of the rate of fuel input; mill-inlet suction; mill outlet temperature; combustion chamber pressure; air/steam flow ratio, and steam temperature, during normal operation. The system thus covers the production of steam from the fuel input stage to the turbine stop-valve. Evershed & Vignoles Ltd. are also supplying generally similar control equipment for the West Thurrock boiler; but in this case it will be extended to also detect load variations in electrical demand.

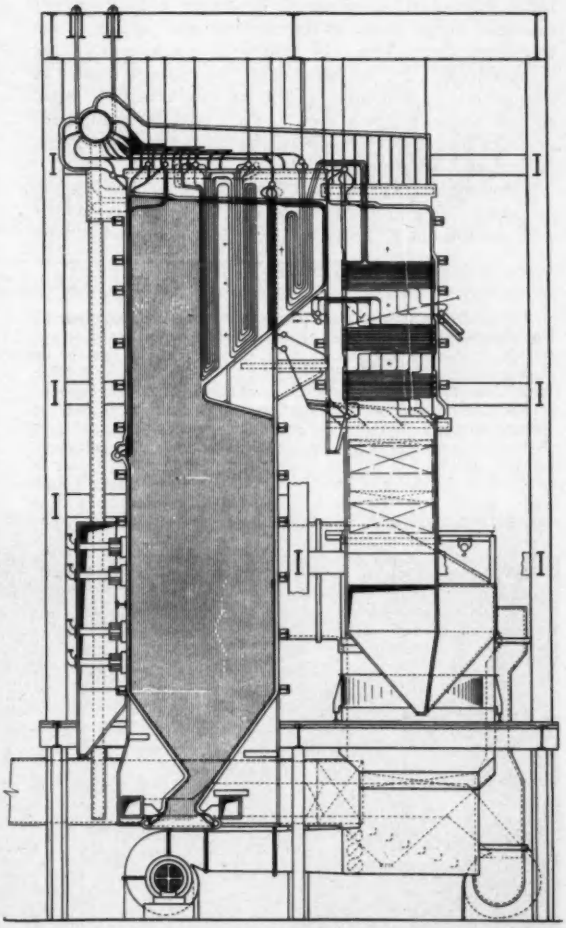


Fig. 4. Sectional outline arrangement of the Babcock 200-MW Radiant reheat boiler for West Thurrock. Maximum capacity is 1,350,000 lb/hr., superheater outlet steam conditions 2,450 lb./sq. in., and 1,055 deg. F. Reheat is 1,220,000 lb./hr. to 1,005 deg. F.

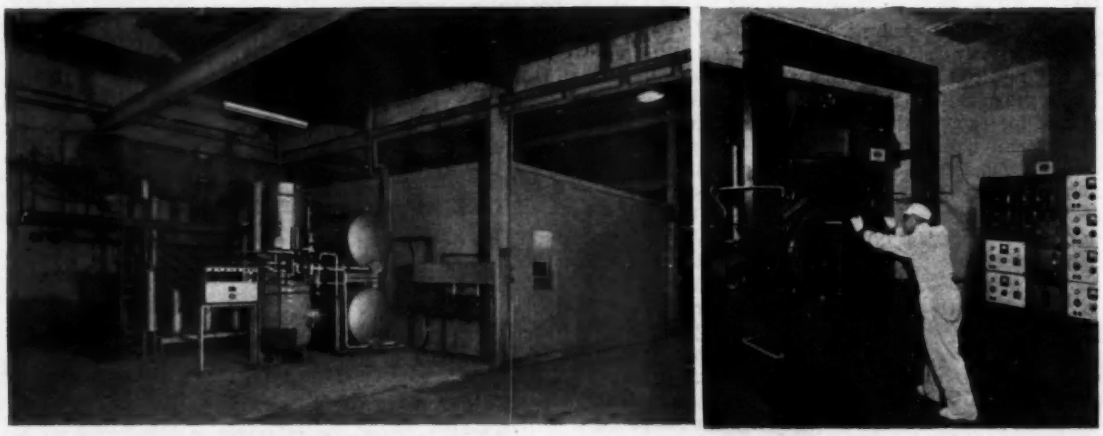
Receiving information from conventional instrumentation, the computer system will perform all preliminary checks before starting up the boiler unit. It will then start up individual items of plant such as fans and p.f. mills, and meanwhile, will adjust the set-points of the analogue controllers to bring the boiler up to normal load as quickly as possible, whilst maintaining all necessary limits, such as maximum metal temperatures in the superheater tubes.

The "Argus" computer for this application uses solid-state electronic components throughout, and, working in binary arithmetic, is capable of performing 50,000 additions or 10,000 multiplications per second. For this boiler control equipment, the programme store of the computer will have a capacity of 4,096 instructions, and the working store, a capacity of 1,024 words. The input equipment is designed to accept a total of 171 analogue signals from 97 transmitters and 32 three-term electronic controllers. In addition, digital signals are accepted from 675 on/off devices. Readings from 150 thermocouples will also be selected, for checking metal and bearing temperatures. The output equipment provides digital drives to about 150 contactors, for control motors and actuators.

Two printers will be used for monitoring and logging purposes. The first will be an operations printer which will continuously provide information on what the computer is doing and how the plant is behaving; the second will print out, at regular intervals, the various temperatures, pressures, etc., attained on the boiler, and also calculated figures indicating the efficiency and general performance of the unit. In addition to carrying out the functions of control and data logging, the computer monitors all the essential alarm points and operating equipment many times each second, thereby providing an additional safeguard against dangerous conditions, arising through equipment failure, or variations in operating conditions. An "Argus" control system used in this way is claimed to offer the advantage of consistent performance in bringing a large boiler/turbine unit on load in the shortest possible time, operating it at maximum efficiency under varying loads, and shutting it down safely and quickly when necessary. All the information concerning the boiler is available centrally, and the performance and efficiency of the unit can readily be assessed.

ULTRASONIC CLEANING PLANT IN SCOTLAND

The establishment of a £20,000 ultrasonic cleaning plant by **Cockburns Limited,** Cardonald, Glasgow, recently, is of particular interest because it is thought to be the first of its kind in Scotland, and one of the first to be operated by a valve manufacturing firm. The standards of cleanliness now required in the manufacture and operation of nuclear plant are, of course, so rigid, that only cleaning by special solvents and ultrasonic waves can meet such requirements. The company has also provided a special clean conditioning room; this is an air-tight structure of insulated steel panels with an air-lock door. Clean dust-free air is filtered to five microns, and is supplied to the room by an air-conditioning plant which maintains an internal pressure of 2 in. w.g., so that dust cannot enter. Because of Glasgow's atmospheric condition, a special fog-filter has been installed. The new cleaning plant consists of a specially-designed autoclave with a revolving carrier, solvent sprays, and transducers in the base for the introduction of ultrasonic power. The autoclave is within the clean conditioning room, and connected to a closed-circuit solvent supply and drying system. This system, which is controlled pneumatically, embodies storage-tanks for preheating and conditioning perchlorethylene solvent, a filter battery pump and ring vacuum pump. For recovery of solvent, a dust-distillation plant has been installed—comprising a still and a condensing unit. This equipment is located outside the cleaning room. The sequence of operation is pre-rinsing, solvent cleaning with ultrasonic waves and vacuum to remove air from all cavities in the component, and vacuum drying, all carried out in the same autoclave at a predetermined temperature. Preconditioned solvent is fed into the autoclave through sprays, while the carrier rotates, exposing all surfaces of the component to the solvent spray. The solvent is recirculated through the filter battery, ensuring complete removal of all solids. After ultrasonic treatment, the load receives a final rinse, solvent is drawn-off, and vacuum is applied to the autoclave for drying. A cooling coil placed in a sump at the back of the unit condenses the vapour in the coil chamber, leaving the work which has been dealt with, perfectly dry and clean, down to 1.5 micron filter. The load is then removed, and components are assembled and sealed in polythene containers, and stored in the clean conditioning room until required for despatch.



The ultrasonic and vacuum cleaning plant installed by Cockburns Limited, Cardonald, Glasgow, showing (left) the solvent cleaning and recovery plant, and (right) valves and fittings being loaded into the autoclave.

Work has recently commenced on a new pump test-house and a new research laboratory at the Bedford Works of **W. H. Allen Sons & Co. Ltd.** The pump test-house will be a single-storey building, consisting of a main building with an annexe on either side. The arrangements in the main building, which will contain a 30-ton crane and a large sump, 20 ft. deep by 32 ft. by 21 ft., will provide every facility for the testing of pumps of all capacities up to 120,000 gal./min. of water. Each annexe will be equipped with a 3-ton crane. The main research laboratory will comprise a two-storey office block, providing 3,500 sq. ft. of accommodation, and an adjoining single-storey laboratory of 2,300 sq. ft.

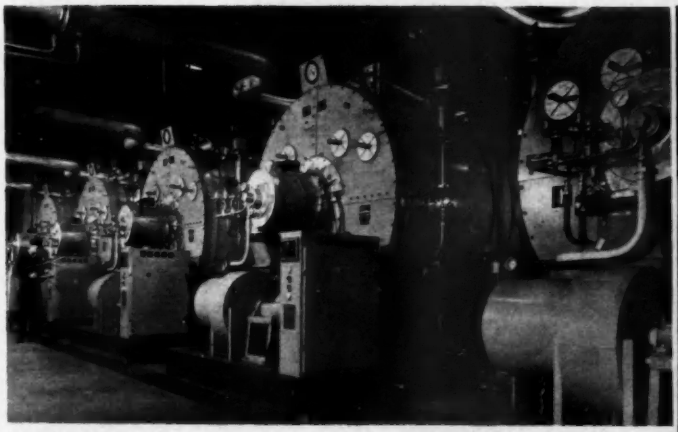
Powermaster Packaged-Type Boiler Installation

WHAT is claimed to be the largest single packaged-type boiler installation in this country, has just been completed by G.W.B. Furnaces Limited, Dudley, Worcs. It is part of a large new factory project being carried out by Henry Wiggin & Co. Ltd., at their works at Hereford. The new factory, which covers an area of approximately 52 acres, will absorb the manufacturing activities of the Wiggin companies at present based in Scotland and at Birmingham. Five "model 600" Powermaster packaged boilers have recently been put into service at these works. The new boilers will mainly be used for space-heating, though a certain amount of steam will be used for process requirements.

Designed to be fired with fuel-oil having a viscosity of 3,500 secs., the units can also be fired with C.T.F. 200 without any modification being required to the furnace or the burners. The five powermaster units will be capable of producing 105,000 lb./hr. of steam, but it will be only during the winter months that all five boilers will be working simultaneously. The boiler house, measuring 78 ft. long × 45 ft. wide, houses in addition to the five packaged boilers, a cold-water make-up tank, two condensate tanks, instrument panel, water-treatment plant and oil transfer pumps. All the relevant ancillary equipment is located in a two-storey bay. The boilers, each of which measures 22 ft. 10 in. long × 9 ft. wide × 14 ft. high, and weighs approximately 2½ tons, were despatched from the makers' works and installed on site within a period of 10 days. The four 24 ft. × 20 ft. oil-storage tanks, which will contain the fuel oil, were built on site. They stand on concrete foundations, and each will hold approximately 50,000 gal. of oil. The tanks are insulated and covered with aluminium sheeting, the latter also fulfilling insulation purposes. In addition, this sheeting provides a more pleasing appearance in the rural environment, surroundings into which the Powermaster units are stated to be well suited, due to their completely smoke-free operation when working under partial or full load conditions.

The formation of the Wiggin Organisation took place in 1835, when a partnership was formed by two men, Evans and Askin, who commenced the refining of nickel, and the manufacture of German silver. In 1842, Henry Wiggin joined the firm and later, gave his name to it. The company developed over the years, initially producing electrical resistance wires and later, many new nickel alloys culminating in the "Nimonic" heat-resisting alloys which are today used in practically every British jet and turbo-jet engine. Due to the demand for these specialised alloys, it soon became obvious that there would have to be an increase in works production facilities.

The Hereford factory was built originally for the Ministry of Supply for the production of "Nimonic" heat-resisting alloys. In 1952, installation of plant commenced at Holmer Road and the first ingot was extruded in 1954. The company purchased the works from the Ministry of Supply two years later with the aim of concentrating all production there, and at the same time, to modernise and further expand production facilities.



(Above). The five Powermaster Packaged-type boilers installed at the Hereford works of Henry Wiggin & Co. Ltd. These boilers which can jointly produce 105,000 lb./hr. of steam will mainly be used for space-heating requirements.

(Right). Supplied with each boiler as part of the unit, the control panel designed by G.W.B. Furnaces Limited is claimed to help reduce operator's time to a minimum.

On completion of this project, it is claimed that the plant will be the largest and most modern metallurgical works of its kind in Europe.

Henry Wiggin & Co. Ltd. has, throughout its history, specialised in the production of nickel and nickel alloys, and it is, today, the largest producer of these alloys outside the United States of America. The basic operations undertaken by Wiggin are the melting of raw nickel with other metals, and the manufacture by extrusion, rolling, and drawing of nickel and a wide range of nickel alloys in the forms required by industry. Perhaps the company's most interesting products are those offering resistance to high-temperature including the " Nimonic " nickel-chromium series of alloys. Alloys in this series were used by Sir Frank Whittle in his jet engine, and soon became established as the standard material for the manufacture of turbine blades for use in British gas-turbines. A second group of corrosion-resisting alloys includes "Monel" nickel-copper alloy, " Inconel " nickel-chromium-iron alloy and " Corronel 210 " nickel molybdenum-iron alloy. These alloys are used in industries as diverse as chemical plants, steam engines of various types, marine requirements and petroleumrefineries. A further group of alloys, very important in the firm's present range of products, are electrical resistance materials. Immersion heaters, furnaces, and demisters for car windows, to quote only a few examples, all depend on these Wiggin materials for their heating elements. Apart from these three groups, other alloys are manufactured having special physical properties which have resulted in their use for many unusual purposes. These alloys fall into groups showing magnetostructive properties, controlled thermal expansion and magnetic properties.

AUSTRALIA'S ATOMIC RESEARCH ESTABLISHMENT

The new metallurgy and engineering building at the Australian Atomic Energy Commission's Lucas Heights Research Establishment, near Sydney, which was recently completed at a cost of £A450,000, was opened on November 18th, 1960, by the Prime Minister, the Rt. Hon. R. G. Menzies. About 450 guests were present, representing all aspects of public life. The building houses the staff and laboratories whose work it will be to develop a " super fuel " for nuclear power stations. The objectives are, first, to provide cheaper sources of nuclear energy, and, secondly, to improve the total utilisation of the potential fuel—that is, to secure a higher " burn-up " rate than the current figure of only 1 per cent. of the fuel. By so doing, it should be possible to make nuclear power fully competitive with coal even in those areas where supplies of the latter are cheap and abundant. To obtain these objectives, it will be necessary to secure higher reactor operating temperatures, and thus a more efficient steam cycle with lower capital cost per installed kilowatt than the current figure of £60 for conventional power stations in Australia.

The Australian research programme is directed to a gas-cooled system using enriched fuel, and particular emphasis is laid on compatibility problems of the materials of construction of reactors. These include corrosion of metals by gases—for example, the effect of carbon-dioxide on metals under irradiation at relatively high temperatures (600 deg. C. compared with 400 deg. F. for the Calder Hall reactors). Radiation damage to graphites is being measured in terms of their thermal conductivity, which falls off rapidly after irradiation. Other physical properties are altered so greatly by irradiation that the change is qualitative and not merely quantitative in nature ; this applies particularly to the principal core materials being studied at Lucas Heights, viz., beryllium, beryllium oxide, and graphite.

The great advantage of beryllium is that it absorbs few neutrons, and that it undergoes fission itself, one Be atom being split into two helium atoms and two neutrons. Compared with this, one atom of uranium material creates only 0.9 atom on fission. Hence, compared with beryllium, uranium causes a gradual rundown of nuclear fuel. Beryllium and carbon are considered to be the two materials best adapted for use as moderators, and their behaviour in a neutron flux is being studied by the physics section. In the engineering section, much mathematical work is in progress on the change of reactivity of nuclear piles with time and with temperature, and on the amount of control needed to secure stability. The possibilities of the gas-turbine, for converting the thermal energy released by a reactor into mechanical power, are also under consideration.

Chemical engineering problems being investigated at the establishment include the processing of fission products, the preparation of beryllium for beryllium oxide and studies of what happens to fission products in a reactor. Erection and testing of a sodium loop has been completed, and an experimental study made of the stability of dilute suspensions of fine particles, for a liquid-metal fuel reactor system. The staff is now engaged on a study of the fabrication and properties of extruded and compacted specimens of graphite containing a high percentage of uranium and thorium as their carbides. For experiments on the extrusion of beryllium, a 1,000-ton hydraulic press with a fast ram speed has been installed ; while for nuclear metal fabrication there is a rolling mill with 100 h.p. 10-in. rolls. On the medical and biological side, there is a team of doctors and scientists who take care of the radiation protection of the staff, and provide an emergency medical service, besides conducting research to find out how radiations affect living material.

Lucas Heights has also a strong isotopes section, in whose work big developments are expected shortly. Besides producing radio-isotopes in the 10-MW research reactor known as HIFAR, the section conducts an advisory service to industry and to other scientific laboratories. The research effort of the section is concerned mainly with problems arising from the advisory service; for example, help is being given with eradication of the fruit fly which causes extensive crop damage in New South Wales. Also, and in conjunction with C.S.I.R.O., the possible use of radiation in food technology is being studied.

Senator W. H. Spooner, Australian Minister for National Development, whose department is responsible for the work of the Atomic Energy Commission, invited industrial firms to take full advantage of facilities at the research establishment, and assured them of the co-operation of the staff. Mr. D. R. Griffith, the power study engineer, said that the cost of nuclear power had been reduced by 30 per cent. in five years, and at that rate of progress nuclear power stations would probably be competitive with coal-fired stations in such areas as South Australia within the next 10 years.

Demonstrations of the use of closed-circuit television for monitoring process measurements—as an alternative to conventional telemetering—were held recently under the auspices of **Woodall-Duckham Construction Co. Ltd.** in the main instrument-panel assembly department of **George Kent Limited,** Luton. The TV equipment was provided by **Pye Limited,** Cambridge. Visitors, who included senior engineers of the gas industry, were able to see for themselves comparisons of picture clarity in various light-intensity environments with camera equipment providing panoramic and close-up shots in association with 8½ in. and 14 in. standard monitors and a 14 in. high-precision monitor.

* * *

The **Central Electricity Generating Board** recently placed a contract with the **Harland Engineering Co. Ltd.,** Alloa, for the booster and main boiler feed pumps for No. 3 unit at Richborough power station (South Eastern Division). The initial plant installation at Richborough will comprise two 120-MW sets with unit boilers of 860,000 lb./hr. capacity. Turbine steam conditions will be 1,500 lb./sq. in., 1,000 deg. F., and reheat to 1,000 deg. F. The first set is scheduled for commissioning in 1962.

RECENT Equipment AND Accessories

Contracts for paper mill drives

Following the commissioning earlier this year of two sectional drives for cellophane coating machines, the Motor and Control Gear Division of Associated Electrical Industries Limited, has received a further order from British Cellophane for three similar drives for installation in Great Britain and abroad. These sectional drives employ unexcited synchronous motors supplied from a single variable-frequency a.c. generator. Amongst other contracts obtained recently by A.E.I. for the paper industry is one valued at approximately £100,000, covering electrical equipment required for a second pulp mill which the Caima Pulp Co. of Oporto are constructing at Constancia in the south of Portugal. This is located on the river Tagus about 70 miles upstream from Lisbon. A.E.I. are to supply power house equipment, low-tension and high-tension distribution switchgear, control gear, as well as nearly all the electric motors required. The new mill is scheduled to start production in the spring of 1961. Initially, it will produce 20,000 tons of sulphite eucalyptus pulp per annum, and there are plans for a later extension which will more than double this capacity. Markets for the pulp will be mainly in Portugal, Belgium, France and the United Kingdom. The mill is being planned and co-ordinated by Boving & Co. Ltd., London, who are also supplying the pulp process machinery. The boiler plant is being supplied by Babcock & Wilcox Limited, and will be associated with A.E.I. generating plant and power distribution equipment. (*Associated Electrical Industries Limited, Rugby.*)

Bellows production

At the Chesser tube works, Edinburgh, of Munro & Miller Limited, the production of an extensive range of bellows has recently been started. The bellows joint (Fig. 1) consists primarily of a length of corrugated tube, the corrugations being termed "convolutions." A simple axial bellows has flanges at each end of the convolutions, and is secured simply to the adjoining pipe work. In other forms, however, the bellows may be gimbal-mounted or may be provided with hinged restraints in order to absorb internal pressure-loading. Whilst the more standard type bellows are fabricated in various grades of stainless-steel and are welded to mild-steel flanges for some duties, where corrosion is a particular consideration, fabrication may be in "Monel" metal. Where high temperatures and pressures are encountered, and where considerable movement has to be accommodated, equalising rings are fitted to the bellows, these rings having the same contour as the convolutions when fully compressed. The function of the rings is to limit the amount of compression on any one convolution to a certain maximum figure and to transfer the thrust to succeeding convolutions.

Although automatic welding is used wherever possible in the joining of the convolutions and the flanges, and other bellows components, much hand-welding is, nevertheless, necessary, especially where the convolutions have been fabricated in stainless-steel whilst the flanges are of mild-steel. Post weld treatment includes the grinding and polishing of welded

Fig. 1. Bellows production at Edinburgh. (Munro & Miller Limited.)

surfaces with Consolidated Pneumatic "Hicycle" high-frequency electric grinders. The models used are C.P. type 5180 straight grinders and 511AG angle grinders, these being operated from a 12-kVA frequency changer. The bellows are subjected to hydraulic and radiographic tests, these being available for inspection by the respective insurance company or the inspecting authorities before acceptance. (*Munro & Miller Limited, Sighthill, Edinburgh.*)

Ambuco venturi scrubber

In the recently-introduced Ambuco scrubber (which is made under licence from Waagner-Biro) the water is introduced ahead of the venturi by means of a special nozzle spraying directly into a specially-shaped entry. The design of the entry is so arranged that the gases are compelled to pass through two complete cones of water. In the first cone, the water droplets are of a relatively large size, and are primarily effective in collecting the coarser solid particles. In the second cone (produced by the venturi entry shape) the droplets are considerably finer and their velocity is reduced. At the same time, the velocity of the gas and dust particles increases as it passes the venturi. This results in ideal conditions for the collision of the dust particles and fine water droplets, with consequent maximum collection efficiency of the finest of particles. For effective gas-scrubbing, the size of the water droplet must be varied to meet varying sizes of solid particles. In the Ambuco scrubber, droplet size is controlled by positioning the water introduction nozzle relative to the venturi entry. This enables optimum results to be obtained for any given set of conditions; and whatever droplet size is selected, the "double scrubbing" principle is maintained. (*Ambuco Limited, Stanbrook House, 2/5, Old Bond Street, London, W.1.*)

Plant for steelworks

Orders for two ore-handling plants, worth a total of £1½ million, have recently been received by The General Electric Co. Ltd. One of these plants, valued at £1 million, is for installation at the Scunthorpe South Works of the Appleby-Frodingham Steel Co. Ltd. The other is for the Ravenscraig Works of Colvilles Limited; the latter brings the total value of orders received by G.E.C. for the Ravenscraig Works during 1960, to £2½ million. The Appleby-Frodingham order which was received through Head Wrightson Iron and Steel Works Engineering Limited, comprises an eight-bed blending plant, and about 15,000 ft. of conveying equipment for the sinter plant. This new installation supplements the original plants supplied by G.E.C. which were commissioned in 1950 and 1954. The blending plant will include three reclaiming-machines (one of which is to be a

in condensate systems

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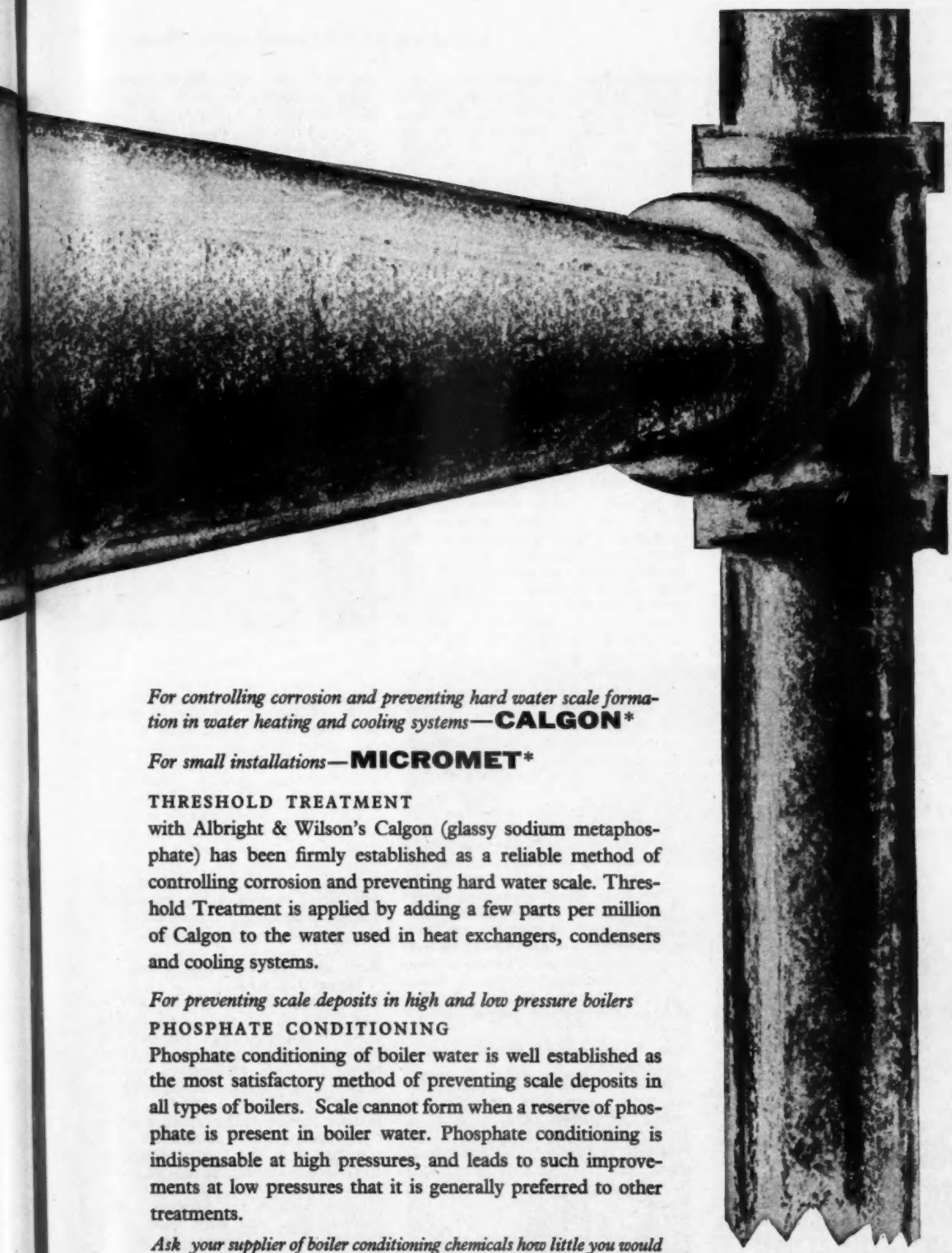

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standby unit), four double-wing stackers and a transfer car. Total storage capacity of the eight beds will be 55,500 tons of ore, which can be reclaimed by the two machines at a rate of 700 tons/hr. Each double-wing stacker has a stocking-out capacity of 735 tons/hr. Three orders cover the ore-handling plant for the Ravenscraig Works at Motherwell. One of these, placed directly by Colvilles Limited, is for stockyard extensions and modifications including a 170 ft. span stocking-out bridge and two double-rotor plough feeders. The feeders are of a new design, each being capable of handling 1,500 tons/hr. of ore. The other orders include one for conveying equipment for a sinter plant, placed through Head Wrightson Iron and Steel Works Engineering Limited, and another for limestone and lime-handling plant, for which Priest Furnaces Limited is the main contractor. The latter order covers conveyors, storage bunkers, and crushing facilities. (*The General Electric Co. Ltd., Fraser-Chalmers Engineering Works, Erith, Kent.*)

The Mark IV chain-grate stoker

James Hodgkinson (Salford) Limited, and Bennis Combustion Limited recently announced the introduction jointly by these two companies of the new Mark IV chain-grate stoker (Fig. 2). The accumulated experience of both companies over a number of years has been combined in this development, and the manufacturers claim that its many design features make this stoker the foremost of its type to be manufactured.

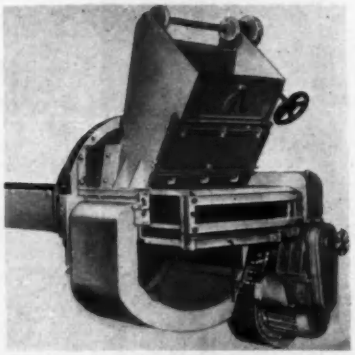


Fig. 2. The Mark IV chain-grate stoker. [James Hodgkinson (Salford) Limited and Bennis Combustion Limited.]

The grate has been completely redesigned—there are now three patterns of links—giving full self-cleaning action and clearer air-spaces for improved cooling and more effective distribution of primary-air, resulting in more efficient combustion and higher output. Link-rods are shouldered for positive tightening without restricting link movement, and there is full-diameter penetration of the side links. A positive and almost friction-free drive is obtained with redesigned front sprockets bearing on all driving-links through rollers incorporated in the grate, and the new rear drum, which supports the full width of the grate. As with previous models, automatic combustion control equipment is available for this new Mark IV chain-grate stoker, and special internal baffles, based on the latest research data, are also available. [*James Hodgkinson (Salford) Limited, Ford Lane Works, Pendleton, Salford, 6, Lancs., and Bennis Combustion Limited, Little Hulton, Walkden, Manchester.*]

Flame failure control

The Photoelectronic flame-failure control, type GFF, has been designed to provide a safety system for oil, gas or pulverised-fuel burners. It operates on the modulation of the flame, irrespective of colour or background radiation, and should the flame go out, then the unit will immediately cut off the supply of fuel. This new unit, produced by Photoelectronic's (M.O.M.) Limited, with its universal application to all types of fuel and its built-in safety circuits, is claimed to provide the solution to many combustion problems. In addition to operating as an on/off device in conjunction with a solenoid valve, the equipment can be fitted with an automatic sequence unit to provide a fully-automatic control system for the burners. This sequence unit comprises a synchronous motor with cam system, and switches to provide a sequence of operations for lighting-up, with the over-riding control of the photocell to ensure complete safety. The equipment is complete with indicating lights to show the condition of operation, while the photocell is contained in a cast-aluminium tube for easy mounting. [*Photoelectronics (M.C.M.) Limited, Oldfields Trading Estate, Oldfields Road, Sutton, Surrey.*]

New "Universal" multi-point recorder

A new version of the multi-point electronic strip-chart recorder, to enable alternatives of 2, 3, 4, 6, 8, 10, 12, 16, 20 or 24 points to be measured and recorded on one instrument, has been recently introduced by Honeywell Controls Limited. Known as the "Universal ElectroniK" multi-point recorder (Fig. 3), it is said to increase the scope of recording different numbers of variables on the same instrument. Range and compensation can also be altered. Research and test departments in many industries are likely to be the most interested in this new development, although the "Universal" is stated to be by no means limited to these fields. Variation is simply obtained in a matter of seconds. The action consists of replacing the print-wheel/indicator-dial, which is fixed by a thumb-tight nut; then replacing a shorting-plug unit on a special input-terminal board inside the instrument. The range of the instrument can also be changed by fitting new range resistor cards (Fig. 3), and can compensate for different types of measuring unit by fitting a new input-terminal board. Honeywell Controls Limited state that the "Universal" design can be supplied on any of their non-control strip-chart recorders, thus giving an economical instrument for research work or process applications where the number of records being monitored changes frequently. (*Honeywell Controls Limited, Greenford, Middx.*)

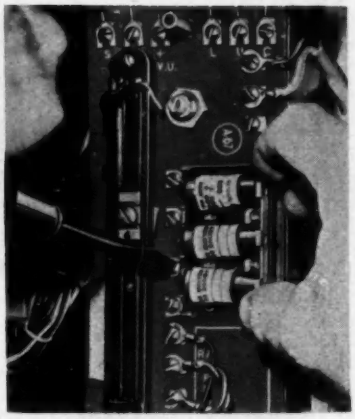


Fig. 3. "Universal" multi-point recorder. (Honeywell Controls Limited.)

New blast-furnace for Ford Motor Co. Ltd.

Ashmore, Benson, Pease & Co. Ltd., one of the companies in the Davy-Ashmore Group, has recently been awarded a contract by the Ford Motor Co. Ltd., Dagenham, to construct a new blast-furnace with a hearth diameter of 20 ft. This furnace represents the fiftieth modern blast-furnace which Ashmore's have constructed in the United Kingdom and overseas during the past 30 years. It is a coincidence that the fiftieth furnace contract for Ashmore's was received from the same client who ordered the first, constructed by the company many years ago. The original unit had a hearth diameter of 18 ft. 3 in. and is stated to have

astonished the industry by its performance. It is claimed to have held, for at least 12 years, every British record for output, and its economical coke consumption has only recently been rivalled by much more modern units. The new furnace is planned to go into production during the summer of 1962. (*Ashmore, Benson, Pease & Co. Ltd., Stockton-on-Tees, Co. Durham.*)

Electronically controlled weighing

Electroweighers (Birmingham) Limited have recently introduced a control weighing equipment (Fig. 4) which functions as follows:—the first material is weighed on an electronic continuous-belt weigher, and signals from the weigher control-unit are fed to an electronic sampler and memory unit. The delayed signals from the memory unit are then used to control the excitation of a vibratory feeder which supplies the required amount of the second material on to another conveyor which, in turn, carries both materials. The belt weighing equipment comprises an electronic control unit and a weighbridge incorporating a linear inductive load cell which weighs the first material. Voltage signals which are dependent upon load, are fed to a memory and sampler unit which registers average load, and retains the signal for the requisite time period (up to 45 sec.) before operating a servo motor-driven toroidal transformer, the voltage output of which supplies variable excitation to the vibrator feeder which in turn varies the flow of the second material. The equipment can be used in any installation or location where mixing and blending are required. Other special design applications are stated to be available to meet specific requirements. [*Electroweighers (Birmingham) Limited, Moseley Street, Birmingham, 12.*]

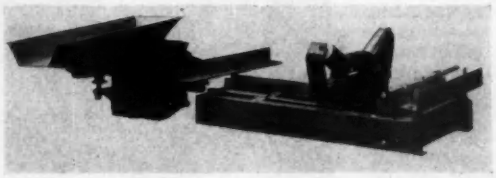


Fig. 4 (left). Electronically controlled weighing equipment. [Electroweighers (Birmingham) Limited.]

Airetool pneumatic tube-expansion control

A new, high-speed adaption of the Airetool pneumatic tube-expansion control, for use in up to and including ¾ in. steel or non-ferrous tubes, has recently been developed by The Airetool Manufacturing Company, U.S.A. Designated as the "Model 900 Airetrol," this new unit (Fig. 5) is lighter in weight than the standard Airetool, and has a quick-reversing handle, helpful in speeding-up production. Development of the "Model 900 Airetrol" extends the use of this production tool into many new areas of industry including, for example, air-conditioning. All Airetrol tube-expansion control units, it is claimed, provide the maximum degree of accuracy, through precise measurement of torque. Tubes can be rolled at the rate of 12 or more per minute with the new unit, to a uniform accuracy of within ± 0.001 of an inch. The Airetrol "Model 900" automatically stops expansion according to a predetermined dial torque setting. This accuracy results in uniformly-tight tube-joints, and there is no "under" or "over" expansion. Airetrol's motor and torque sections are separate, self-contained units, allowing for easy maintenance. (*The Airetool Manufacturing Company, Springfield, Ohio, U.S.A.*)

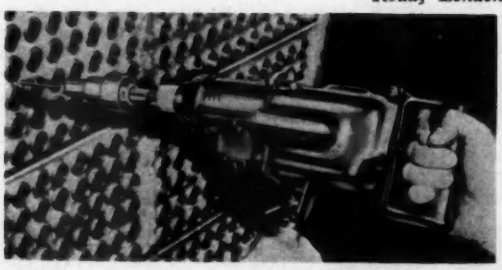


Fig. 5 (left). "Model 900 Airetrol" tube expansion control. (The Airetool Manufacturing Company.)

Fig. 6 (right). C.P. "Magnamatic" screwdriver. (Consolidated Pneumatic Tool Co. Ltd.)

New C.P. "Magnamatic" screwdriver

A new torque-controlled screwdriver and nutrunner, incorporating a "magnamatic" clutch and known as the "CP 3008-LMS-1600" (Fig. 6), has been introduced by the Consolidated Pneumatic Tool Co. Ltd., to meet the demand for a tool which, it is claimed, will eliminate damage such as stripped threads and distorted workpieces, due to application of excessive torque during tightening of screws and nuts. The new magnetic clutch is formed by a magnet, housed inside a pair of mating, cylindrical jaws. At one end, the jaw cylinder is tapped to accommodate the threaded shank of the cylindrical magnet which fits inside the jaws, whilst a steel disc is located at the other end of the cylinder. The jaw teeth are curved and tooth-shaped, the depth to which they interlock being governed by the number of turns made in the magnet shank. In operation, the torque required to separate the two jaws depends upon the depth of engagement. When the required torque value is reached, the jaws disengage, the lower jaw being held out of engagement by a latch, which is released when the tool is withdrawn from the work. The screwdriver is equipped with a lever handle and has a nominal capacity screw-size range from No. 4 to No. 8. The range of torque-adjustment is from 5-20 in. lb. on soft pull-up work, whilst on free running "sudden-stop" work, the maximum torque value is 40 in./lb. The overall length of the tool is 10 in., and the net weight is 1 lb. 14 oz. The air-inlet thread size is ¼ in. (*Consolidated Pneumatic Tool Co. Ltd., 232, Dawes Road, London, S.W.6.*)

Stream-line filtration of spark-erosion machine dielectric

Spark-erosion is, of course, a process used in connection with the machining of "difficult alloys." The function of spark-erosion is to vaporise the metal by a high-frequency discharge, each spark vaporising a fragment of metal while it is immersed in a dielectric—usually paraffin or transformer oil. The performance of the machine depends upon the absolute cleanliness of the dielectric liquid, and in this connection Stream-Line Filters Limited have been working in close co-operation with the manufacturers, in order to produce their latest filter design, which is a

unit ensuring the complete removal of all the eroded particles. This new filtration unit incorporates a Stream-Line filter which embodies the principle of the manufacturers' well-known edge-filtration, and recognised as the perfect practical method of removing all traces of solid matter from liquids. The construction of the unit is so arranged that filtration can be either continuous or in batches according to requirement. For continuous filtration, the unit is coupled directly into the spark-erosion oil-line and forming a closed circuit, while the dirty liquid flows into the filter where it is cleaned and returned to the machine. For batch filtration, there are two 20-gal. tanks—the dirty one in the front and the clean one at the back—each with a separate motor-driven pump. The liquid in the dirty tank passes through the filter and flows into the clean tank ready for transferring to the spark erosion machine. Valves and cocks in the piping circuit make it easy for the required filtration system to be brought into operation. A suitable metal drawer is situated at the base of the filter in order to catch the sludge when the filter is cleaned by blowing compressed-air through the packs in the reverse direction. (*Stream-Line Filters Limited, Henley Park, Guildford, Surrey.*)

18 MeV Betatron X-ray unit

Head Wrightson (Teesdale) Limited have placed an order with Pantak Limited for an 18 MeV Siemens Betatron. This mobile particle-accelerator (Fig. 7), one of the most sensitive X-ray units currently planned for use by U.K. industry, can be used for examining steel of thicknesses up to 16 in., and reflects the growing trend towards welded fabrications in plate of increasing thickness and of denser metals. This trend is particularly pronounced in the fabrication of pressure-vessels for the nuclear power and the refrigeration industries. This new unit will operate in Head Wrightson's heavy fabrications shop at Thornaby-on-Tees, and will, it is stated, require less radiation safeguards than those which must be adopted for other particle accelerators and high-power sources. Amongst the first applications of the Betratron are expected to be those of weld examination on the 4-in. thick plates for the steam-raising units (or heat-exchangers) for Dungeness nuclear power station, now under construction by The Nuclear Power Group—formed last year by the Association of A.E.I.-John Thompson and the Nuclear Power Plant Company. For this duty, an examination of a 4-in. thick weld can, it is claimed, be made in less than 2 min. The extremely fine size of the platinum X-ray source or focal spot, at 0.3 mm. × 2 mm., is of particular significance in the Betatron. This feature is responsible for the high-definition contact radiography which will be carried out with this unit, in which wire penetrameter sensitivities of 0.3 per cent. will be possible when examining 10 in. thick steel plate. It also governs the enlargement technique in which such fine flaws as that of a crack some 0.1 in. deep in a 10-in. thick plate can be observed in addition to other defects which would be beyond the range of such equipment as conventional X-ray units, isotopes and linear accelerators. The Betatron radiation head, which uses an 800 lb. magnet assembly to accelerate electrons almost to the speed of light in a doughnut-shaped tube before grazing the platinum target, weighs one ton, and is gimbal mounted to allow any sequence of exposures to be made at any angle without the need for re-locating the machine. It is provided with internal shielding and the radiation output falls away rapidly outside the useful beam, thus simplifying personnel protection problems. Practical working conditions are frequently obtained with mobile steel protecting screens, these limiting the radiation exposure area to a minimum. (*Pantak Limited, Vale Road, Windsor, Berks.*)

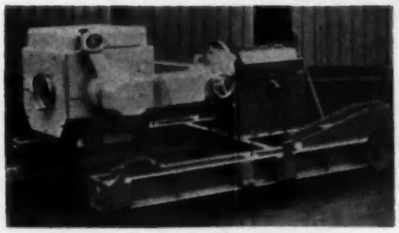


Fig. 7 (left). 18 MeV Betatron X-ray unit. (Pantak Limited.)

Packaged type boiler plant at a Hampshire laundry

Approximately two years ago fire completely gutted the Hampshire premises of Chandler's Ford Laundry Limited. Buildings, machinery, equipment and customers orders were all destroyed. All that was saved were some of the company's records. Today, however, this laundry, which is part of the Capital & County Laundries Limited group, is being rebuilt on the same site, and when completed, it is expected to be one of the best equipped laundries in Britain. All the equipment is modern, both in design and performance. A new boiler-house has been installed which houses a Model 200 "Powermaster" oil-fired packaged-type boiler (Fig. 8) supplied by G.W.B. Furnaces Limited. Before the fire occurred, the laundry relied on a hand-fed coal-fired boiler, the steam output of which was 5,000 lb./hr. The "Powermaster" is capable of generating 7,000 lb./hr. of steam at a pressure of 150 lb./sq. in. and it is anticipated that the boiler will have a thermal efficiency of 83 per cent. In actual fact, during the final performance test at the manufacturer's works, the calculated efficiencies at high and low combustion conditions were 84 × 86½ per cent. respectively. The "Powermaster," installed by the laundry's own engineering staff, will easily cope with sudden peak loads by means of its automatic operation which adjusts its steam output in accordance with the demands made on it. Because it takes up to 50 per cent. less floor space than that required by an equivalent conventional boiler, the "Powermaster" was able to reduce initial boiler-house building costs. A 7,000 gallon capacity oil-storage tank is located near to the boilerhouse. The oil passes through the pre-heater mounted on the boiler itself before being fed to the Voriflow medium-pressure air-atomising burner which is a patented exclusive feature of the "Powermaster." The boiler provides steam not only for laundry production, but also for thermostatically-controlled heating of the factory, office buildings and canteen. The laundry building itself is contemporary in design, and is well insulated. The roof is of aluminium decking, with a

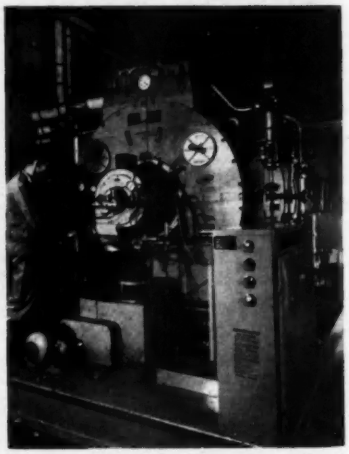


Fig. 8. Model 200 "Powermaster" oil-fired packaged-type boiler. (G.W.B. Furnaces Limited.)

double-glazed roof light, surmounted by a wide opening ventilator. Steam pipes, water pipes, electric cables, etc., serving each item of equipment are all placed underground. The laundry itself is located in a wooded, residential suburb midway between Southampton and Winchester, surroundings into which it fits ideally. This is possible because the boiler is both smokeless and quiet in operation. The activities of Chandler's Ford Laundry include, as well as domestic and contract work, a linen hire service to hotels and shipping concerns. An interesting feature of the contract work is that the laundry offers a guaranteed delivery service of four hours for ships' laundry, when sometimes there are as many as 5,000 separate items to be dealt with laundered at one time. (*G.W.B. Furnaces Limited, Boiler Division, Dudley, Worcestershire.*)

Lancashire Dynamo Electronic Products Limited, Rugeley, Staffordshire, a company in the Metal Industries Group, has concluded a licence agreement with **Emerson Electric Manufacturing Company,** of St. Louis, Missouri, under which the American company will have the right to manufacture in the United States on a royalty basis, the complete range of industrial electronic control equipment which the British company have manufactured over the past 15 years. The agreement provides for a continuing flow of "know-how" to Emerson on new developments in equipment and manufacturing techniques. Among products covered by the agreement are a complete range of specialised adjustable speed drives for all types of industrial process, regulator equipment, circular and strip-chart recorder/controllers for the process industries, machine-tool control systems, a wide variety of photo-electric equipment, resistance-welding controls and many other specialised devices for automatic control in industry. The agreement, which was signed in St. Louis at the end of January, in addition to providing for the flow of "know-how" to the U.S. company, also covers a reciprocal flow of similar information in respect of advances in the design of the equipment covered by the licence.

* * *

A new general chemicals catalogue has been issued by **Albright & Wilson (Mfg.) Limited,** the largest manufacturing company of the Albright & Wilson group. An insert section shows the way in which these chemicals are used throughout British industry in the production of a multitude of industrial and consumer products in every day use. The General Chemicals Department of Albright & Wilson (Mfg.) Limited handles all grades of chemicals from technical to those of high-purity for specialised industries such as the pharmaceutical industry. Albright & Wilson (Mfg.) Limited, as the major manufacturing company within this international chemical group is the main producer of phosphorous and its derivatives in the United Kingdom. Its interests embrace the production and sale of phosphoric acid, organic phosphorus compounds, inorganic phosphates and the development of a fast growing range of industrial finishing processes.

* * *

The new Winn flexiseat pivoted disc valve is fully described in a four-page colour leaflet issued by **B.W. Valve Co. Ltd.,** 140, Granville Street, Birmingham, 1 (the proprietors of this company being **Charles Winn & Co. Ltd.**). Illustrations include a cut-away diagram showing the operation of the unique "spot-tight" closure system.

F.A. (Membranes) Limited, St. Helens, Lancs., have recently made available a new range of Oppanol Sheeting. This poly-isobutylene thermoplastic sheeting for waterproofing insulated pipelines has hitherto been supplied in a thickness of 1 mm. Now, a $\frac{1}{2}$ mm. sheeting is available supplied in rolls 90 ft. long × 39 in. wide. It can be cut to shape with a knife or scissors, worked around the insulated pipe with 2 in. edge and 3 in. end laps, the overlaps being welded together by a brushed on solvent and pressed down by hand. This operation welds the two thicknesses of sheeting together, giving a lap which is as water and vapourproof as the sheeting itself. Oppanol does not age or rot, is proof against acid attack and corrosion. Once installed no maintenance is required; the saving over a period of years, therefore, can be considerable. It is easy to handle and rapid of application as compared with other materials employed for water-proofing insulated pipelines. It withstands temperatures from minus 30 deg. to plus 70 deg. C., and can be painted to any colour required. Although providing a superior finish which requires no maintenance, the initial cost of installation is no greater than the conventional roofing felt, wire mesh, bituminous paint treatment. Oppanol ($\frac{1}{2}$ mm. thickness), therefore, provides one of the most effective and economical pipeline waterproofing treatments on the market today.

* * *

Teleflex Products Limited, Basildon, Essex, have recently obtained an important overseas order from Electrohelios of Mariestadt, Sweden, for four Teleflex E.8 conveyors. Valued at £18,500, this order was obtained in the face of strong competition from other British mechanical handling equipment suppliers, as well as from German and Swedish manufacturers. The new conveyors are to be installed in a new factory now under construction which will increase the Swedish company's output of commercial refrigerating plant. They will be used to bring assembly parts such as electric motors from the factory basement to the production lines, and will carry components through the various stages of paint pretreatment and finishing.

* * *

Work is now well-advanced on another large modern building at the **Cambridge Instrument Company's** factory in Chesterton Road, Cambridge. The new building, which will be similar in appearance, and joined at one end to the company's new research laboratories, will consist primarily of two floors supported at first-floor level by a series of reinforced-concrete pillars. The top floor will house testing, assembly and wiring departments, and the first floor will be devoted to enlarged production space for the company's microscan X-ray analyser, and to works offices. The area beneath the first floor will be almost wholly taken up by car parking-space, and by a loading bay with gantry and platform. An important feature is a double-deck bridge that will connect the building to existing production departments, and provide additional space for a calibration room, etc. The building, which is expected to be ready for occupation in July next, adds approximately 16,000 sq. ft. of floor space to the 20,000 sq. ft. provided by the research laboratories, which were opened by Lord Adrian in October, 1959. The mode of construction will give a clear area on all floors uninterrupted by columns or beams and extensive use is being made of new materials and techniques.

* * *

John Thompson Industrial Constructions Limited ("Induscon"), a member of the John Thompson Group of Companies, has taken over the administration of the **John Thompson Conveyor Co. Ltd.** This reorganisation, within the group, takes effect immediately, and **Mr. A. T. Shaw,** managing director of "Induscon" will now direct the activities of the John Thompson Conveyor Company. Prior to this reorganisation, the Conveyor Company was regarded as a department of John Thompson (Wolverhampton) Limited, which, in turn, is a wholly-owned subsidiary of John Thompson Limited. "Induscon," also a subsidiary of John Thompson Limited, has its head office at Tavistock House East, Woburn Walk, Tavistock Square, London, W.C.1. It appears that the change was purely an administrative one, and that the existing premises of the John Thompson Conveyor Company at Manor Road, Ettingshall, Wolverhampton, would continue for all project, contract and engineering work. Coinciding with the reorganisation is the appointment as manager of the Conveyor Company of **Mr. R. T. McGregor,** who will also continue as sales engineer of "Induscon."

* * *

The Dutch motor vessel *Carebeka* was recently chartered by Danish buyers to convey a cargo of refractory materials from Britain. The cargo consisted of "Tri-Mor" high temperature castable refractories, manufactured by **Morgan Refractories Limited,** Neston, Cheshire—a member of **The Morgan Crucible Group.** The consignment, worth £20,000, is for use instead of firebricks in the lining of two large power station boilers in Denmark. This highlights once again the modern trend towards the use of monolithic refractory linings for boiler and like constructions.

OVERSEAS Steam Engineering Practice

Abridgments of recent articles in the colonial and foreign technical press, concerning design and progress in the technique of steam generation and power plant equipment

Ruien Steam Power Station, Belgium

In its technical conception, its high degree of automatic control and its architectural design Ruien Power Station, in East Flanders, is stated to be one of the most up-to-date generating plants in Belgium. The plant efficiency, including the power requirements of all auxiliaries needed for normal operation, is over 37 per cent., which is remarkably high for a plant consisting of two 60-MW boiler-turbine units. At present, this figure is only surpassed in Belgium by Baudour Power Station, which operates at a higher temperature and has an overall efficiency of nearly 40 per cent. Ruien has two boiler-turbine units, the output of each of the two generating sets being 60-MW. The steam enters the turbines at 140 kg./sq. cm. gauge and 540 deg. C., and is reheated to 540 deg. C. (1,991 lb./sq. in. g., 1,004 deg. F., reheat to 1,004 deg. F.). Sulzer Bros. Ltd. were entrusted with the construction of the two steam generators for an output of 185 tonnes (408,000 lb.) per hour each. The consulting engineers for the station were the Bureau d'Études of the Compagnie Générale d'Entreprises Electriques et Industrielles (Electrobel), Brussels, and it is operated by the Société Intercommunale Belge d'Electricité, working in parallel with other Belgium power stations. Each of the steam generators at Ruien is designed to operate at steam conditions of 145 kg./sq. cm. (2,060 lb./sq. in. g.) and 546 deg. C. (1,015 deg. F.) at the superheater outlet, and 32.8 kg./sq. cm., (467 lb./sq. in. g.) and 546 deg. C. (1,015 deg. F.) at the reheater outlet, with a feedwater temperature of 237.5 deg. C. (460 deg. F.). The efficiency guarantee was based on non-bituminous coal having the following characteristics:—

Net calorific value, 4,890 kcal/kg. (8,742 B.Th.U./lb.) (for raw coal).
Volatile constituents, 12 per cent. (for dry fuel).
Water, 10 per cent.
Ash, 30 per cent. (for dry fuel).
Ash softening point, 1,190 to 1,280 deg. C. (2,170 to 2,335 deg. F.).
Ash fusion point, 1,320 to 1,480 deg. C. (2,405 to 2,695 deg. F.).

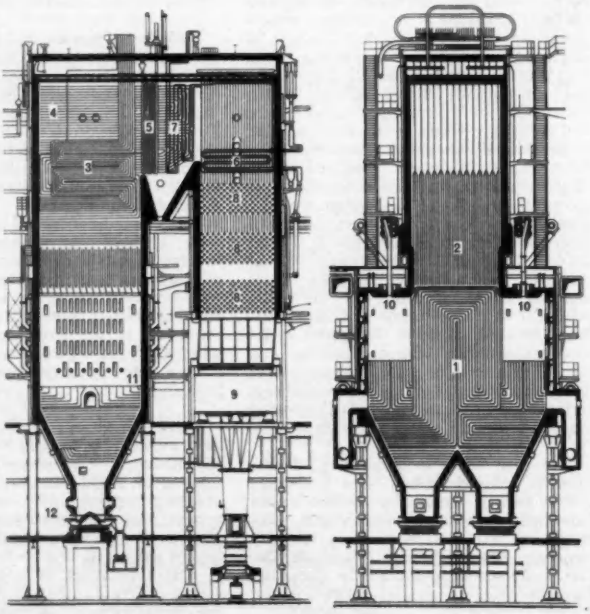
The combustion chamber has had to be designed to meet the following requirements of the clients:

Trouble-free operation on Belgian and foreign coals lying between the following limits:—

Net calorific value, 4,050 to 4,200 kcal./kg. (7,290 to 7,560 B.Th.U./lb.) (for raw coal).
Volatile constituents, 10 to 20 per cent. (for dry fuel).
Water, 20 per cent. max.
Ash, 45 per cent. max. (for dry fuel).

Trouble-free operation between 60 and 185 tonnes/hr. (132,000 and 408,000 lb./hr.) on all the above types of coal. The final reheater temperature must be kept at its nominal level down to a steam output of 85 tonnes/hr. (187,000 lb./hr.) or 46 per cent. of the maximum continuous rating, and for this reason it was decided to employ a double-U firing system. A large proportion of the tubes in the furnace is exposed so that it is possible to burn these coals, in spite of their poor ignition qualities, without a supporting oil flame, even at partial loads. The coaling plant operates on the indirect firing principle, i.e., with intermediate bunkers for the ground and dried coal. The fuel goes by way of conveyor belts from the storage yard to the raw-coal bunkers, whence it is fed to the ball mills, of which there are two for each boiler. Here it is ground and dried with re-aspirated flue gases and hot air. The coal dust is then separated off in two cyclones, while a fan returns the gas to the steam generator. The pulverised-coal is now stored in bunkers from which it is taken by bucket-wheels to be mixed with the primary-air and blown into the combustion chamber. In addition to the two pulverising-mills for each boiler, a fifth is provided as a standby between the two boiler-turbine units. The gases from this mill, which can serve either boiler, are not returned to the furnace, but expelled to the atmosphere through an electrostatic precipitator. The steam generators operate on the well-known Sulzer

Sections through Sulzer Monotube steam generator installed in Ruien steam power station.



Monotube principle. The control system consists of well-tried hydraulic components—electric equipment is used only for supervision and remote control—and comprises control loops for feedwater, water-level in the separator, temperature, pressure and the bypass system. The reheat temperature is controlled by injecting water into the high-pressure steam before entry to the Triflux. Suitable choice of the temperature of the high-pressure steam entering the Triflux, and of the position and size of the reheater bank, enables the full reheat temperature to be maintained even at partial loads as low as 30 per cent. The two 60-MW turbo-alternator sets supplied by Escher Wyss A.G., Zurich, operate on live steam at 141 kg./sq. cm. abs. and 540 deg. C. (2,005 lb./sq. in. and 1,005 deg. F.) and at a mean cooling-water temperature of 12 deg. C. (55 deg. F.). The feedwater temperature is raised to 237.5 deg. C. (460 deg. F.) in six heaters, of which four are low-pressure and two, high-pressure units. The guaranteed heat-consumption of each turbo-alternator set, at its economical load, is 1,980 kcal./kWh (7,857 B.Th.U./kWh) measured at the terminals. The rating of the hydrogen-cooled alternators is 80 MVA. (*Sulzer Technical Review*, Vol. 42, 1960, No. 1.)

Steam for ice disposal in seaway locks

Four mobile package type boilers are being used in an interesting application on the St. Lawrence Seaway to thaw ice on the locks. The boilers were specially designed for the purpose by the Cleaver-Brooks Company, Milwaukee, Wis., U.S.A. Costing about $20,000, the four 1,200 lb./hr. boilers were delivered to Massena, New York, where they were put to work to provide steam to melt the ice accumulated on the lock stop-logs. These stop-logs are barriers consisting of 10 steel plates approximately 90 ft. wide and 8 ft. high. and reinforced at the back by heavy angle construction. Two stop-logs are lowered into slots on the canal side of the locks, and as soon as they are in position, the lock is pumped dry and the gates are moved to the half-open position and stored during the winter months. These stop-logs are not completely water-tight and there is some seepage of water through the cracks. The water freezes on the inside of the locks, resulting in ice up to 48 in. thick. During mild weather, when water accumulates within the lock, it is usually pumped out to prevent any damage to the gate due to any further freezing. Over each stop-log on the lock side, a canvas-covered enclosure is formed having dimensions of approximately 90 ft. wide by 80 ft. high and 10 ft. deep. Into this enclosure and on temporary supports, two unit heaters are placed, these having sufficient capacity to maintain a temperature of 70 deg. F., with outside conditions at minus 10 deg. F. Mounted on hard rubber-tyred wheels for portability, the boilers are moved into position, and each feeds steam, at the rate of 1,200 lb./hr., to the unit heaters and to a steam gun which the operating personnel can use to blanket the lock surface. The resulting blanket of steam and warm air thus thaws the ice collected on the gate's surface, allowing the gate to be opened or closed as required. The boilers are 15 ft. long, 4 ft. wide and 5 ft. 6 in. high, and each weighs about 5,000 lb., while the specially-constructed frame with wheels provides mobility along the runways of the locks. Each unit is equipped with a water make-up tank which holds sufficient water for approximately one hour's operation. A simple hose-connection from a local water supply provides the water at 20 to 40 lb./sq. in. pressure for continuous and automatic operation. The units are fired with light oil, and each boiler has an oil-storage tank of 80 gal. capacity—sufficient for seven to eight hours of operation.

A contract valued at approximately £1 million, for what will be the world's most powerful hydraulic turbines of their type, has been awarded by the Manitoba Hydro Electric Board to the **English Electric Canada Division** of the **John Inglis Co. Ltd.**, Toronto. The contract was won against strong Canadian and international competition. When installed in 1964 at Grand Rapids Generating Station on the Saskatchewan River, where it empties into Lake Winnipeg, the three English Electric Kaplan-type turbines will produce an additional 450,000 h.p. for the Southern Manitoba area. Kaplan turbines have movable blades which are adjusted automatically to the varying load and pressure requirements to maintain high-efficiency operation. The design studies for the turbines are being carried out at English Electric's Netherton Works (Lancs.), and model testing will be done at the company's hydraulic laboratories in Rugby. Manufacture will begin early next year in Toronto. Delivery of the turbines is to begin in 1962, and the complete £50 million Grand Rapids project is scheduled for commissioning in 1964.

* * *

Sir Walter Benton Jones, Bt., has retired from the board of Davy-Ashmore Limited, and **Mr. M. F. Dowding** has been appointed a director. Mr. Dowding is general manager of the machinery division of Davy and United Engineering Co. Ltd., one of the Davy-Ashmore subsidiary companies.

The second of the three blast furnaces at the new Durgapur Steelworks which is under construction near Calcutta for the Government of India by the **Indian Steelworks Construction Co. Ltd.,** ISCON, was put into operation on February 2nd, 1961. The lighting-up ceremony was performed by the Indian Minister for Steel, Mines and Fuel, Sardar Swaran Singh. No. 1 blast furnace has been in operation since December last year, and has produced over 380,000 tons of iron to date. Work on No. 3 blast furnace is very nearly completed, and this furnace will also be ready in a few weeks' time. Each of the three blast furnaces at Durgapur Steelworks is capable of producing 1,250 tons of iron per day. Among the distinguished visitors attending the ceremony was Sir John Wrightson, chairman of Head, Wrightson & Co. Ltd., the member company of ISCON responsible for supplying the blast furnaces.

* * *

Mr. E. H. Browne, C.B.E., deputy-chairman of the National Coal Board, has been awarded the highest honour that can be awarded to a professional mining engineer. He has been presented with the Institution Medal of the Institution of Mining Engineers (which was incorporated by Royal Charter in 1915). There are only three other mining engineers still living who hold this distinction, viz.:—**Sir Charles Reid, Sir Andrew Bryan** and **Mr. John Brass,** Sen. Mr. Browne was president of the Institution in 1957/8.

Metal Industries Ltd. announces the appointment of **Mr. R. J. F. Howard** as director of Marketing. In this new post Mr. Howard will be primarily concerned with the co-ordination of the marketing activities of the electrical companies within the M.I. Group. Mr. Howard was previously a director of Lancashire Dynamo Electronic Products Limited. He remains a non-executive director of that company and also joins, in a similar capacity, the boards of five other M.I. subsidiaries: Brookhirst Igranic Limited, Lancashire Dynamo & Crypto Limited, Foster Transformers Limited, J. G. Statter & Co. Ltd., and Lancashire Dynamo Nevelin Limited.

* * *

The removal of the Midland Branch of **Teleflex Products Limited,** to new and bigger office accommodation was recently completed. The new address is Lichfields House, Ringway Centre, Birmingham. **Mr. George Wheeler** continues as executive in charge.

* * *

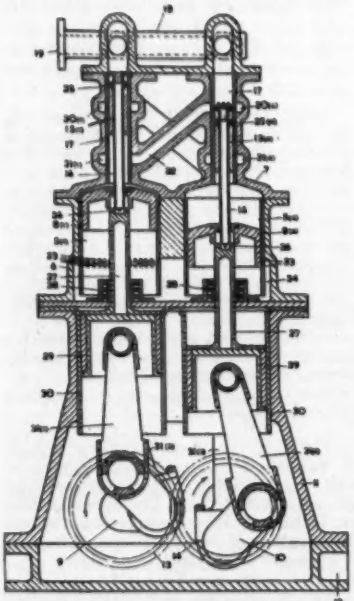
Mr. H. Martin, home sales manager of Murex Welding Processes Limited, Waltham Cross, Herts., retired recently, on reaching retiring age, after 38 years' service with the company. **Mr. R. E. H. Bell,** assistant home sales manager for the past 10 years has been appointed home sales manager. **Mr. K. Leevers,** A.M.I.Mech.E., A.M.I.E.E., and **Mr. P. Hobbs,** B.A. (Cantab.), have been appointed assistant home sales managers (technical). **Mr. S. E. Smith** has been appointed plant sales manager.

Latest Power Plant Patents

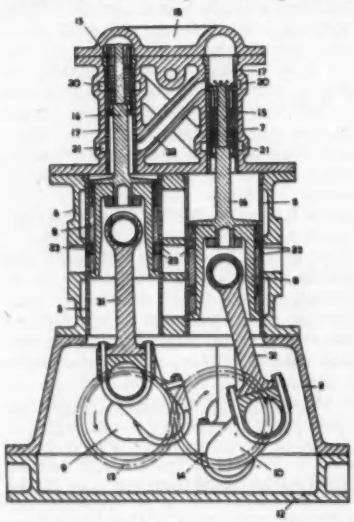
These extracts from British Patent Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2. Price 3s. 6d. each, both inland and abroad.)

Steam engine

This invention directly concerns steam, or other expansible fluid, reciprocating engines. Referring to Fig. 1, the steam engine shown has four cylinders, and corresponding members of the four similar assemblies are designated by the same reference numeral, individual members being distinguished where necessary by the addition in parenthesis of one of the numerals 1 to 4. The four cylinders are constituted by liners (5) secured in a common body casting (6) and are closed at their inner or working ends by a common head casting (7). The cylinders (5) have their axes parallel and disposed at the corners of a square. The pistons (8) working in these cylinders are coupled in pairs to two parallel



two-throw crank shafts (9 and 10), which are journalled in a casing (11), supported on a base casting (12), and are coupled together by a pair of gear wheels (13 and 14), so as to rotate at equal speeds in opposite directions. As shown, the cylinders are disposed vertically and above the horizontal crank shafts, the inner or working ends of the cylinders being consequently uppermost. The cranks and gears are so arranged that when one piston (8.1) is at top dead-centre, as shown, the other piston coupled to



Figs. 1 (left) and 2 (above). British Patent No. 857,380.

the same shaft, i.e. shaft (9), is midway of the up stroke; the adjacent piston coupled to the second shaft (10) is at bottom dead-centre; and the other piston (8.4) coupled to shaft (10) is midway of the downstroke. Admission of steam is controlled by piston valves (15) which are carried on tail rods (16) extending upwards from the pistons (8) and work in valve cylinders constituted by liners (17) secured in the head casting (7). The valve cylinders (17) open at their lower ends into the respective power cylinders (5) and at their upper-ends into a common steam-chest (18), having a steam inlet branch (19). The wall of each valve cylinder is formed with two ports (20 and 21), each constituted by a ring of apertures in the liner (17) communicating with an annular channel in the head casting (7). The upper port (20) (here referred to as the transfer port) of each line of parts communicates through a short, straight passage (22) formed in the head casting with the lower port (21) (here referred to as the inlet port) of the next line of parts, that is the transfer port (20.4) communicates with the inlet port (21.1) and so on. The upper edge of piston valve (15.4), for example, uncovers its transfer port when power piston (8.4) is midway of the downstroke and power piston (8.1) is at the top of its stroke, or at any desired degree of lead before this position is reached. A small amount of lead is provided in the construction illustrated, the pistons (8) being shown in the positions described and transfer port (20.4) being then already open. Steam is thus admitted to cylinder (5.1) since valve (15.1) is then wholly above its inlet port (21.1). Transfer port (20.4) remaines open during the whole of the down-stroke of piston (8.1), but the admission of steam to cylinder (5.1) is cut off when the lower edge of valve (15.1) closes its inlet port (21.1), cut-off being effected at any desired position of the piston by suitably choosing the length of the valve. Inlet port (21.1) is again uncovered during the upstroke of piston (5.1), but piston (5.4) is then near the upper end of its stroke, so that the transfer port (20.4) is closed and steam is not again admitted to cylinder (5.1) until transfer port (20.4) is uncovered when piston (5.1) is again at (or at any desired position before) top centre. Thus, admission of steam to each cylinder is controlled by a valve moving with the piston of an adjacent cylinder and cut off is controlled by the corresponding valve of the cylinder concerned. The piston valves may be disposed in line with the axes of the power cylinders, as shown or they may be offset towards one another to reduce the distances between the valve cylinders and the lengths of the steam passages (22). The engine operates on the Uniflow system, steam being exhausted from each power cylinder (5) through ports (23) in the wall of that cylinder, which are uncovered by the piston (8) when at the lower end of its stroke, into an exhaust chamber (24) in the cylinder casing (6). To prevent excessive compression during the upward stroke of the piston of the steam remaining

in the cylinder, which would be particularly objectionable at low engine speeds, the construction shown in Fig. 1 is provided with a secondary exhaust system. Each piston valve (15) operates with its ends intermediate with a port (25) which communicates with the exhaust chamber (24) through the bore of the tubular tail rod (16), and a port (26) on the lower side of piston (8). Port (25.4) registers with transfer port (20.4) during the downstroke of piston (8.4) and at a time when piston (8.1) is nearing the end of its upstroke and inlet port (21.1) is open, thus relieving the pressure in cylinder (5.1). The arrangement is, of course, such that port (25) has completely passed port (20) before the upper end of the valve member reaches port (20) and opens it to the steam supply from steam chest (18). Ports (25.4) and (20.4) will also come into register at an earlier point in the upstroke of piston (8.1), while piston (8.4) is on its upstroke; it may be arranged that port (21.1) is open at this time also, thus giving two periods of secondary exhaust. The passage provided by port (25) is of restricted cross-sectional area so that at higher engine speeds there is considerable wire-drawing of the secondary exhaust, and the compression is relieved much less than is the case at low speeds. The form of engine shown in outline in Fig. 2 is generally similar in construction and operation to that shown in Fig. 1, but it is of substantially reduced overall height, although the pistons have the same length of stroke. The pistons (5) are of the trunk type, directly-coupled to the connecting rods (31), the cross-heads and guides being omitted. No secondary exhaust system is provided, the space left in each power cylinder (5) above the piston (8) when the latter is at the top of its stroke, together with the space left between the tail rod (16) and the surrounding valve cylinder (17) and the space provided by the passage (22), being sufficient to provide the clearance volume required for satisfactory running. The piston valves (15) are built up from cup shaped members and spacer discs threaded on to the tail rods (17), which in this case are of solid construction. *British Patent No.* 857,380 *issued to K. W. Willans. Complete specification published December 29th,* 1960.

P.F.-fired steam generator

This invention concerns a boiler plant having two or more independent combustion chambers adapted to be fired by pulverised-fuel, the slag to be removed in a molten condition. A slag-screen is provided between each of the chambers. The arrangement in accordance with the invention of two or more separate combustion chambers allows them to be spaced mutually at a distance such as to provide an intermediate space for the insertion of a suitable brickwork structure as well as for the supply of air channels and other constructional elements necessary for the operation of the boiler. This arrangement has an additional advantage in so far as the operation of one combustion chamber does not influence all other

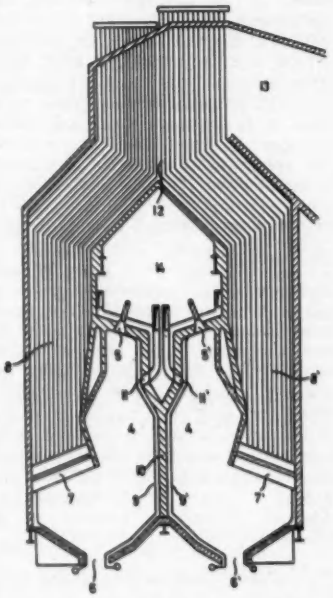


Fig. 3 (above). British Patent No. 858,016.

combustion chambers. The arrangement of separate radiation spaces individual to each stream of combustion products produces the result that in the case of partial loads requiring the operation of only one chamber, the combustion gases of this one chamber are not cooled down in the radiation space connected to it to such a degree as would be the case with a radiation space common to all chambers and dimensioned too large for this partial load flow. The flue gases, therefore, enter into the heat transfer surfaces of the boiler following the radiation space at a temperature approaching that obtained with full load. The invention is outlined in Fig. 3 which shows a longitudinal section through a water tube boiler fired by two separate combustion chambers. Burners (5, 5′) are located on the roof of two L-shaped combustion chambers (4) lined in the usual manner with cooling pipes. At the lower ends of the chambers (4) are arranged outlet openings (6, 6′) for molten slag. After reversal of the direction of flow of the flue gases through about 180° they pass through slag screens (7, 7′) into radiation spaces (8, 8′) at the end of which they are at a temperature near the softening point of the slag. Between the bounding tube walls (9 and 9′) of the two combustion chambers is located brickwork (10) having air-passages (11 and 11′). After junction of the flue-gas streams at the point (12), the flue-gases flow in the usual manner through the radiating and contact heating surfaces (13) of the boiler. The burners and the air-heating passage can be reached through a chamber (14) accessible from the outside. *British Patent No.* 858,016 *issued to Walther & Cie, A.G. Complete specification published January 4th,* 1961.

Combustion of materials of very low calorific power

The object of this invention incorporates a method and apparatus permitting to effect a combustion of materials containing an unusually small percentage of combustible matter and more particularly the

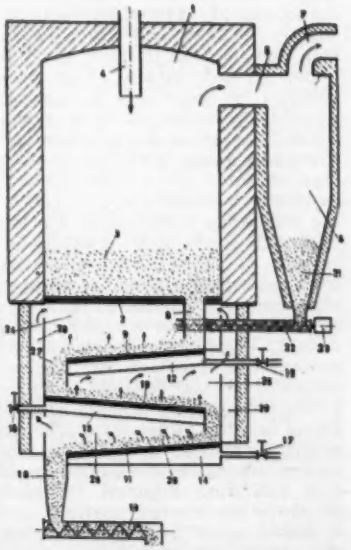


Fig. 4 (above). British Patent No. 858,462.

utilisation by combustion of carbonaceous material of very low calorific power, down for instance to about 600 calories per kilogram, or even less, containing a large percentage of ash (up to 85 per cent. or more), such as rejects from washing plants, and more particularly of sterile shale rejected by the washing plants of collieries. Fig. 4 shows, by

way of example, an elevational section of an apparatus which may be used according to the invention for the combustion of sterile shale obtained from a washing plant of a colliery in the form of small pieces having a size of about 1-10 mm., a low calorific power of 600 to 1,000 calories per kg., containing about some 85 per cent. of ash. Such a shale is considered at present to have little or no value, and is rejected to the waste heaps of the colliery. The furnace (1) has a rectangular, horizontal section permitting a combustion in a turbulent semi-suspension state; (2) is a perforated bottom of the furnace through which air is injected under pressure into a bed of shale (3) in which it induces a turbulent semi-suspension state. There is a conduit (4) for continuously feeding the raw shale; (5) is an outlet for the combustion gases which pass through a cyclone (6), collecting all fine ash in the combustion gases. These gases are led through a passage (7) to the utilisation plant (not shown). The numeral (8) indicates an outlet tube for burnt shale, having a rectangular, horizontal section, the length of which is approximately equal to the width of the furnace. The numerals (9, 10, and 11) show plates which are slightly inclined and are provided with fine openings through which air under pressure passes. This air is supplied by boxes (12, 13 and 14), respectively connected to a general conduit for air under pressure (not shown) by means of regulating valves (15, 16 and 17). The reference number (18) shows a hopper collecting the cooled burnt shale, (19) is a measuring screw which regulates the amount of burnt shale withdrawn from the hopper (18) and at the same time ensures a sufficiently tight joint fit for the cooling device. An annular circular heat insulated casing (20) receives the preheated air from the various levels, and brings it under the perforated plate (2), through which it passes into the furnace (1). The ash carried over and collected by the cyclone are marked (21), the numeral (22) indicating a screw which is driven by a motor (23) provided with a change-speed gear which brings the ash to the top of the cooling device. Under the combined action of the withdrawal of the burnt shale effected by the screw (19) and of the flow passage through the material of the air injected through the plates (9, 10 and 11), the burnt shale is brought into motion and passes through the tube (8) upon the cooling plate (9) and progresses towards the outlet whilst being submitted to successive coolings upon the plates (9, 10 and 11). The slope of the plates (9, 10 and 11) is chosen sufficiently low so that material, which is not aerated, shall not spontaneously advance upon these plates but shall move slowly downward as soon as the injection of air has sufficiently aerated it, as in the case of the "air slides" used to convey cement. The relative thickness of the layers may, to a large extent, be regulated by varying the amount of air delivered to the boxes (12, 13 and 14) by means of the valves (15, 16 and 17). A sufficiently tight joint fit is ensured between the enclosures (24, 25 and 26) by vertical columns of small section (27 and 28), which are continuously kept filled with material. The outline arrangement shows three cooling plates only, but it is obvious that any other number of plates may be provided. An apparatus of the type described, is capable of burning coal shale or steriles from the washing plants of collieries sized about 1 mm. to 10 mm. (0.039 to 0.39 in.) containing 80 to 95 per cent. or even more of ash, and producing combustion gases at 1,050 to 1,100 deg. C., the latter temperature being limited only by the softening point of the burnt shale. The burnt shale leaves the cooling apparatus at a temperature about 20 deg. C. higher than the initial temperature of the cold combustion air which is injected in the cooling apparatus. *British Patent No. 858,462 issued to Compagnie des Metaux d'Overpelt Lommel et de Corphalie.*

Two phase contradirectional flow tube

The subject of this invention is a device for two-phase contradirectional flow within a single tubular member. It has been found that heat transfer obtained by the boiling of a suitable liquid in contact with, or adjacent to, sources of heat, is a more effective method of cooling these sources than that obtained by forced convection of a gas or liquid. This is of particular value where space is not available for the provision of large gas or liquid ducts, such as is the case in the rotating members of electrical machines, or where a large heat flux is to be transferred through a small surface area. According to this invention, liquid introduced into a rotary tubular member moves in a combined rotational and longitudinal movement as a layer on the inner surface of the tubular member in one direction towards a rotary component connected with the tubular member, in which component it is vaporised. The vapour developed is reintroduced into the centre section of the tubular member, proceeding as a vapour core in the other longitudinal direction towards the end at which the liquid has been introduced, and from which the vapour is discharged. Referring to Fig. 5, a rotating hollow shaft (5) has a diagrammatically represented arrangement for admitting liquid to the system and withdrawing vapour from the system denoted by (6) as a whole, and an arrangement denoted by (7) as a whole which rotates with the shaft. Liquid is supplied to the source of heat (not shown) in the rotating member, and vapour or a mixture of liquid and vapour is returned to the hollow shaft. Liquid under sufficient pressure is admitted to the shaft through a pipe (10) between rotary seals (11 and 12) and by way of one or more passages (13) drilled through the shaft wall.

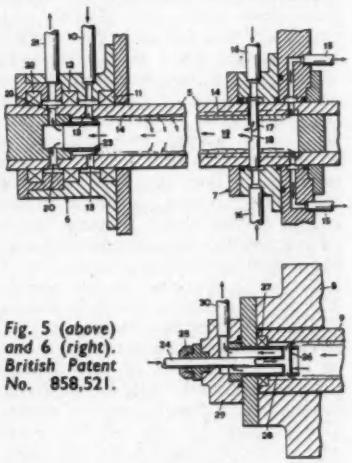


Fig. 5 (above) and 6 (right). British Patent No. 858,521.

Rotational energy imparted to the liquid by the rotating shaft causes it to form a liquid layer (14) in contact with the inner surface of the hollow shaft. The same centrifugal action causes the liquid to be withdrawn from the shaft by way of tubes (15) of the required number to supply liquid to the rotating parts to be cooled. Flow along the shaft may be assisted by providing a tapered bore as indicated by the broken lines in the diagram. Vapour produced by boiling the liquid, together with any remaining liquid carried over or entrained by the vapour, is returned by way of tubes (16) to a tube or tubes fixed into the shaft wall, projecting inward through the liquid film and having an opening or their open ends situated within the diameter of the inner surface of the film. A single tube (17) is shown in the Fig. 5, having a common outlet (18) and two inlet ends situated symmetrically about the axis of the shaft. The vapour, being of lower density than

the liquid, is retained as a core (19) centrally disposed within the liquid annulus, and is withdrawn by way of passages (20) through the shaft wall and a tube (21) situated between rotary seals (12 and 22). These seals (11, 12 and 22) may be of the face type, which provides a positive sealing action. In some cases, labyrinth glands or packings may also be suitable. A tubular mouth piece insert (23) may be provided to assist the formation of a liquid annulus at entry and to prevent droplet entrainment by the returning vapour. A typical alternative construction for the liquid admission and vapour withdrawal arrangement is shown diagrammatically in Fig. 6 as being particularly applicable to the case where a free shaft end is available. An end casing or other stationary component (8) is associated with a rotating shaft (9) to which liquid is to be supplied and from which vapour is to be withdrawn. Liquid enters through a tube (24), which passes through a gland seal (25), and is discharged through radial tubes at (26) to form a rotating annulus of liquid in the rotating shaft (9). Only one rotary seal (27) of the same type as (11, 12 or 23) is employed to prevent escape of liquid and vapour to atmosphere, which seal is situated within the bore of the hollow shaft where the rubbing speed is less than at the outside diameter. A tubular mouthpiece insert (28) is mounted in a stationary member (29) through which the vapour core is withdrawn by way of a tube (30). *British Patent No. 858,521 issued to The English Electric Co. Ltd. Complete specification published January 11th, 1961.*

An order worth over £½ million has been received by the transformer division of **C. A. Parsons & Co. Ltd.,** for four 180-MVA transformers for the Central Electricity Generating Board, Elland sub-station, Yorkshire. These transformers are three-phase auto-transformers for inter-connecting the 275-kV grid systems. Cooling is of the ON/OFB type, and each unit will be fitted with three single-phase linear resistor tap-changers giving plus and minus 15 per cent. variation in 18 steps of 1.67 per cent. at the 132-kV terminal. Each transformer will also be provided with a 13-kV tertiary winding. These units are similar to two other 180-MVA auto-transformers installed by Parsons, and now in operation at Keadby power station.

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A new £5 million slurry-burning power station is to be built in Fife by the **South of Scotland Electricity Board.** Mr. William Hutton, deputy-chairman of the board, who announced this on January 19th, said it would be generally similar to the Barony station in Ayrshire, the economic success of which has encouraged the board to go ahead with a similar venture. A list of possible sites has now been narrowed down to four, but a final decision, Mr. Hutton said, was unlikely to be taken for several months. The new station is expected to be commissioned in 1965. Like Barony, it will have an installed capacity of 60 MW (two 30-MW sets) and will burn about 250,000 tons of slurry each year.

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Smiths Industrial Division have appointed **Mr. Haydn Hollyman** as area representative for the Midlands, in succession to the late **Mr. V. P. Scholes.** He will be responsible for the sales of boilerhouse and process control instrumentation in the counties of Leicester, Stafford, Shropshire, Derby, the Birmingham area and Mid-Wales. He can be contacted at Smiths Industrial Division's area office: 184, Corporation Street, Birmingham, 4; telephone: Central 8737.

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Simon-Carves Limited have been awarded a contract by the West Midlands Gas Board for the supply and erection of an Otto Continuous Reforming Plant to produce 5 million cu. ft./day of towns gas from commercial butane. The plant is to be erected at the Nechells Works, Birmingham, of the Board.

Lodge-Cottrell Limited, Birmingham, have received a contract to supply and build for Richard Thomas and Baldwin Limited, scarfer fume-cleaning plant at that company's Spencer Works, Newport. The approximate value of the contract is £54,000, and the plant will consist of a precipitator, I.D. fan, ducting, dampers, chimney and h.p. pumps. In addition, they have secured from Guest Keen Iron & Steel Works, East Moors, Cardiff, a contract valued at £251,000 for blast-furnace gas-cleaning plant. The plant will have two static washing towers and two precipitators. Also included will be crude and clean-gas mains with gas-valves, instrumentation and cables, water-cooling, clarification and sludge pumps, cold water, hot water and high pressure pumps, water mains and valves, H.T. rectifier transformer equipment, switchgear, motors and starters. The plant is designed to deal with 4 million cu. ft./hr. of gas at N.T.P., and to clean down to 0.004 grain/cu. ft.

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An important shipment from the transformer factory at Wythenshawe, of **Associated Electrical Industries Limited,** a few weeks ago, was an A.E.I. 225-MVA three-phase generator transformer for Willington "B" power station. This transformer is the largest size of generator transformer so far built for the Central Electricity Generating Board. The transformer, voltage ratio 16.5 kV to 295 kV at no-load, will step-up the generator voltage for supply to the super-grid. The A.E.I. high-speed resistor-transition on-load tap changer (removed for transportation) will cater for high voltage variations of ± 10 per cent. in 18 equal steps, and will be suitable for local and remote electrical control. Cooling is by forced-oil circulation and oil-to-water heat-exchangers. Fully assembled, the transformer is 34 ft. 3 in. long, 19 ft. wide and 25 ft. 6 in. high, and weighs 256 tons. For transportation, it measured 28 ft. 6 in. long, 13 ft. 4 in. wide and 15 ft. 6 in. high, and weighed 167 tons.

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Viscount Ward of Witley, who resigned as Air Minister last October, has joined the board of Horsley Bridge & Thomas Piggott Limited, Tipton, Staffs.

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Mr. F. J. B. Barry has been appointed commercial manager of The General Electric Co. Ltd., engineering works, at Witton, Birmingham.

Machining Wiggin high-nickel alloys

As an aid to fabricators who undertake machining operations, **Henry Wiggin and Co. Ltd.** have produced both a new publication and a film on the machining of their high-nickel alloys. Machinability is a function of mechanical properties, and it is only to be expected that materials with the combination of high strength and durability, which is characteristic of these high-nickel alloys, should call for a machining procedure differing in detail from that applied to metals and alloys with lesser properties. It is the object of both the film and the publication to indicate these differences. We were recently invited to attend a showing of the film which deals in turn with sawing, abrasive wheel cutting, fusion cutting, turning, boring, milling, drilling, tapping, broaching, precision grinding, thread cutting, thread rolling and spark erosion. Tool geometry, speed of cutting and choice of coolant are also dealt with. The film (16 mm. colour and sound) will be of considerable interest to production engineers, machine operators and design and planning staff. Henry Wiggin and Co. Ltd. will supply, on loan, copies of the film to engineering societies and to industrial concerns. The publication (Machining Wiggin High-Nickel Alloys, Serial Number 1941) is also available free to any interested readers. Application for either publication or film should be made to:—Henry Wiggin and Co. Ltd., Thames House, Millbank, London, S.W.1.

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Elliott-Automation Limited announce that for certain applications, joint marketing arrangements have now been arranged between **The Rheostatic Co. Ltd.** and **Black Automatic Controls Limited,** both member companies of the Group. Under these arrangements Rheostatic will sell the wide range of Black solenoid-operated valves, pressure and flow switches to the heating, ventilating and air-conditioning industries under the name "Black-Satchwell" alongside its own well-known range of Satchwell controls. In future also the Rheostatic Company will, as appropriate, include "Black-Satchwell" Controls when offering comprehensive control schemes for these industries and to manufacturers of gas and oil-fired boilers. At the same time, Black Automatic Controls Limited is opening a sales office in London at Steel House, 11, Tothill Street, London, S.W.1 (Whitehall 5814-5).

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NOTES *Personal* AND *Industrial*

The Council of the **Institute of Marine Engineers** have recently announced that **His Royal Highness The Prince Philip,** K.G., has honoured the Institute by accepting the invitation of the Council to become president of the Institute for 1962/63.

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Fibreglass Limited announce that **Mr. John Creek** has been appointed deputy managing director in addition to his present appointment as sales director. Mr. Creek joined Fibreglass Limited in May, 1952, as general sales manager, and was appointed to the Board as sales director in 1954.

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Mr. M. A. L. Banks, Mr. A. F. McDonald and **Mr. R. B. Southall,** C.B.E., have been appointed to the board of British Hydrocarbon Chemicals Limited, and **Mr. C. E. Evans,** O.B.E., has been appointed managing director.

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Mr. A. Broomhead has been appointed deputy managing director of Thos. Firth & John Brown Limited, and **Mr. F. Wortley** a director of the company has been appointed general works manager.

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Mr. E. O. Charlton, A.M.I.Mech.E., has been appointed manager of the London office of W. H. Allen Sons & Co. Ltd., in succession to **Mr. F. A. B. Andrews,** who retired recently after 53 years' service with the company. Mr. Charlton, who received his training at the Heaton Works of C. A. Parsons & Co. Ltd., Newcastle upon Tyne, joined the staff at W. H. Allen Sons & Co. Ltd., Bedford, in 1934, and worked in the Condenser and Steam Turbine Sections of their Engineering Department. Since 1944 he has been responsible for the company's steam turbine sales and contracts, both for industrial and commercial marine applications.

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Mr. David Morgan Rees, former chairman of the South-Western Division of the National Coal Board, has been appointed chairman of Rhymney Engineering Co. Ltd. **Mr. John Mayer,** B.Sc., A.M.I.Mech.E., F.Inst.F., joint managing director, International Combustion (Holdings) Limited, has been appointed deputy-chairman. **The Rt. Hon. the Viscount Hall** and **Mr. Alfred Read** have retired from the board. **Mr. W. M. Regan** has been appointed secretary of the company.

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Mr. G. D. Toogood, A.M.I.Mech.E., M.Inst.F., has been appointed sales manager of the Superheater Co. Ltd., Mr. Toogood is a director of Heat Exchangers Limited.

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Aiton and Co. Ltd., Derby, announce that **Mr. R. H. Boissier** has been appointed as their London area manager, in place of **Mr. G. R. H. Trollope,** who has resigned.

The General Electric Co. Ltd. announces that **Mr. T. B. O. Kerr** has been appointed deputy managing director. It also announces that **Mr. E. H. Davison** has been appointed financial director of the company. Courtaulds Limited has agreed to release him from his position as treasurer, to enable him to commence his new duties as from March 1st, 1961.

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Mr. Kenneth H. Platt, M.B.E., B.Sc., M.I.Mech.E., has been appointed secretary of The Institution of Mechanical Engineers, in succession to Mr. Brian G. Robins, M.Sc.(Eng.), M.I.Mech.E., as from June 1st.

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Sir Josiah Eccles is to resign as a deputy chairman of the Electricity Council on July 31st next. He has told the Minister of Power that he wishes to make way for younger men. Sir Josiah has been 33 years in the electricity supply industry, and a deputy chairman of the council since its formation in 1957.

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Mr. J. R. Rowlands, who is a director of Henry Simon (Holdings) Limited, and managing director of Simon Handling Engineers Limited, has been appointed a director of Simon-Carves Limited. **Mr. G. P. Bridges** has retired from the board of Simon-Carves Limited. He was for many years manager of Simon-Carves' Building Department and has been a director of the company since 1954.

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We regret to record the death of **Mr. R. Y. Sanders,** F.S.S., F.R.Econ.S., F.R.Met.Sec., which took place, suddenly, on February 3rd. Mr. Sanders retired from the post of deputy commercial and development adviser to the Electricity Council in September, 1959, but had continued to serve the council in a consultative capacity.

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George Kent Limited have appointed **Mr. Rodney Kent** to be deputy-chairman, and **Mr. Walter May** to be assistant managing director of the company. In addition, **Mr. John G. Vaughan,** F.C.A., managing director of the Charterhouse Finance Corporation has been appointed as a director of the company.

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Bailey Meters & Controls Limited announce that **Mr. Llewellyn Young,** M.I.Mech.E., M.I.Mar.E., M.Inst.F., has been appointed as a director of the company. Mr. Young assumes the position of director of engineering and, in consequence, relinquishes the position of general manager.

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Mr. J. Henderson, M.I.Mech.E., M.I.P.E., etc., has been appointed general works manager of C. A. Parsons & Co. Ltd., in succession to **Mr. W. Winter,** who retired on December 31st, 1960.

It is with regret that we record the death, which occurred suddenly, on January 30th, of **Mr. William McKay,** M.I.Mech.E., M. Inst.F., managing director, La Mont Steam Generator Limited. Mr. McKay, who was 58, had previously served as chief engineer from 1947-1959. Prior to joining the company he was head of the La Mont Boiler Department of Ivor Power Specialty Co. Ltd., and was for some years a member of the technical staff of International Combustion Limited.

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Kestner Evaporator and Engineering Co. Ltd. states that coincident with the retirement of **Mr. J. Arthur Reavell,** M.I.Mech.E., M.I.Chem.E., from the chairmanship of the group and his appointment as president, the following changes have been made in the board: **Mr. B. N. Reavell,** M.I.Mech.E., M.I.Chem.E., has been appointed chairman; **Mr. G. H. Black,** managing director; and **Mr. C. A. Pither,** director and secretary, on the retirement of **Mr. W. S. Knight,** after 47 years as director and secretary. **Mr. J. W. Grose,** A.M.I.Chem.E., continues as an executive director.

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Dr. E. I. Ackroyd has been appointed deputy managing director of the Permutit Co. Ltd., and **Dr. T. V. Arden** as a director of the company.

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Additional factory premises in Wimbledon, S.W., have been acquired by the **British Rototherm Co. Ltd.,** Merton Abbey, London, S.W.19, the scientific instrument makers. The Wimbledon works, which are in the course of being equipped with the most modern plant, will accommodate a machine shop, dial thermometer production unit, and bulk stores.

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A new company, **Petro Engineering Services Limited,** has been formed to give service to industry in the design, purchase, manufacture and erection of petro chemical, and also medium to heavy engineering plant. This is purely a British Company, the chairman and managing director of the new company being **Mr. A. C. Wilson.** The registered office will be—Longfield House, 18/20, Uxbridge Road, Ealing, London, W.5, and there will also be a branch office—Oak House, Cross Street, Sale, Cheshire. Mr. Wilson was, until recently, chairman and managing director of A. C. Wilson & Partners Ltd.

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The Instrument Division of **Newman Industries Limited,** Yate, Bristol, has been renamed Newman Electronics—Division of Newman Industries Limited. Announcing the change of name, Mr. Hedley Newman, assistant managing director, said that they were in the process of expanding the division and the new title was more in keeping with the range of products.